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Hagiwara et al.

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(54) **LIQUID DISCHARGING APPARATUS**

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B41J 2/18	(2006.01)
B41J 2/14	(2006.01)

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CPC B41J 2/14145; B41J 2/14201; B41J 2/155; B41J 2/175; B41J 2/17523; B41J 2/18; B41J 2002/14419; B41J 2202/12; B41J 2202/20

See application file for complete search history.

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(57) **ABSTRACT**

In the first head unit, the first supply port is positioned on a first side, which is one side of the first direction, and the first exhaust port is positioned on a second side, which is the other side of the first direction with respect to a center of the plurality of first nozzles, and in the second head unit, the second supply port is positioned on the second side and the second exhaust port is positioned on the first side with respect to a center of the plurality of second nozzles. The first head unit and the second head unit are arranged in a second direction intersecting with the first direction.

16 Claims, 13 Drawing Sheets

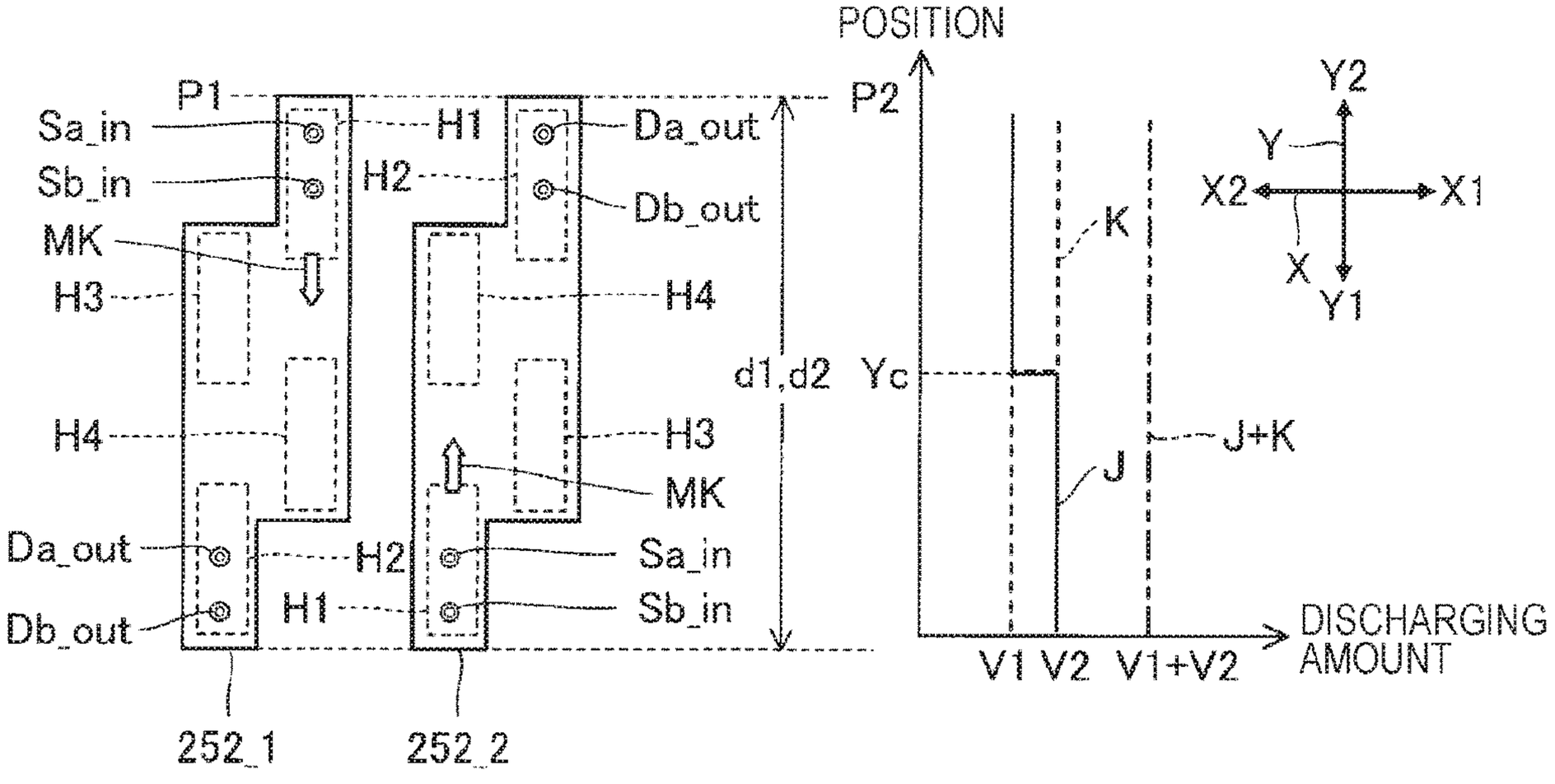
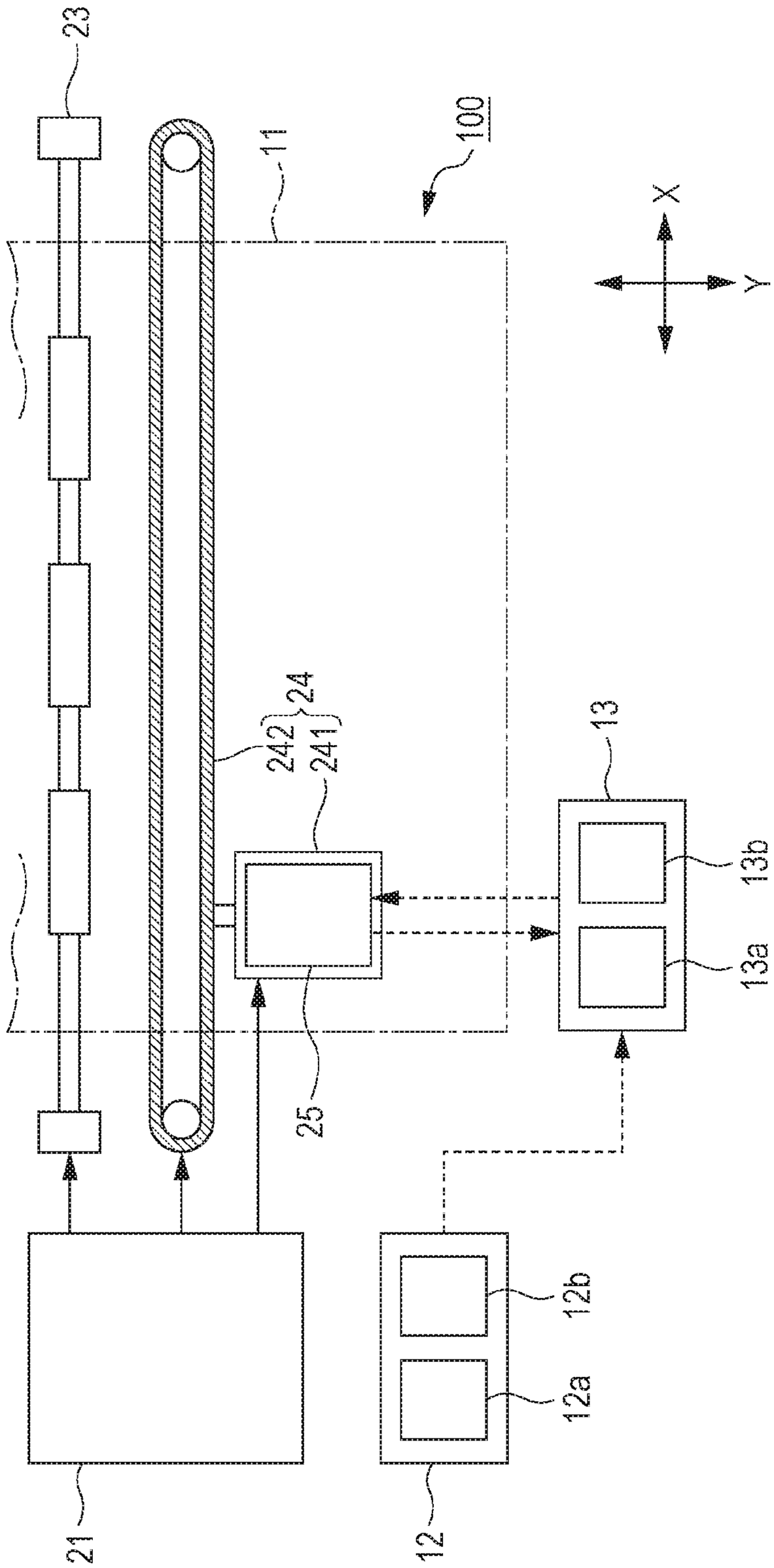
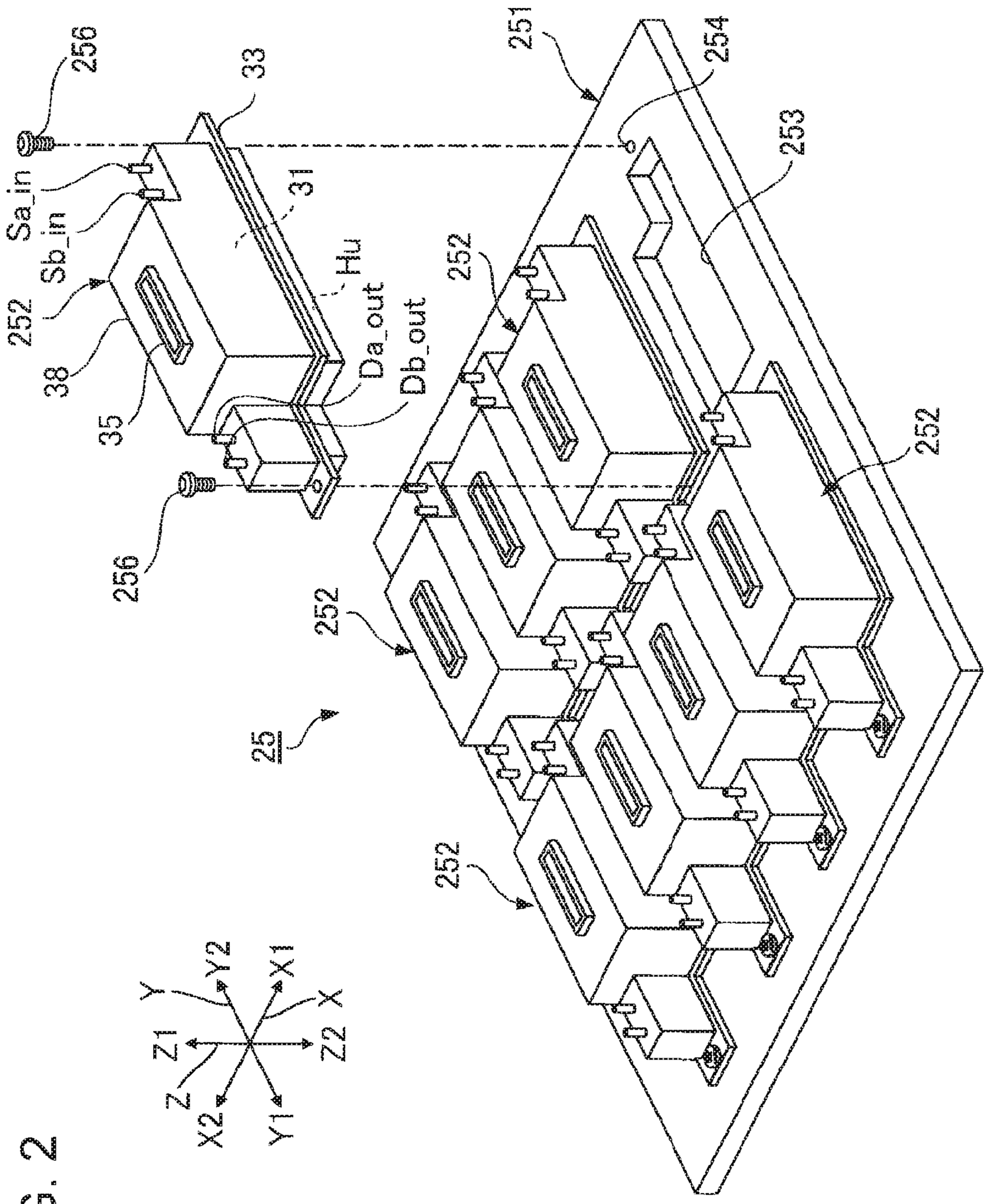


FIG. 1

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33
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254
253
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Sb_in
31
252
Hu
38
Da_out
Db_out
35
252
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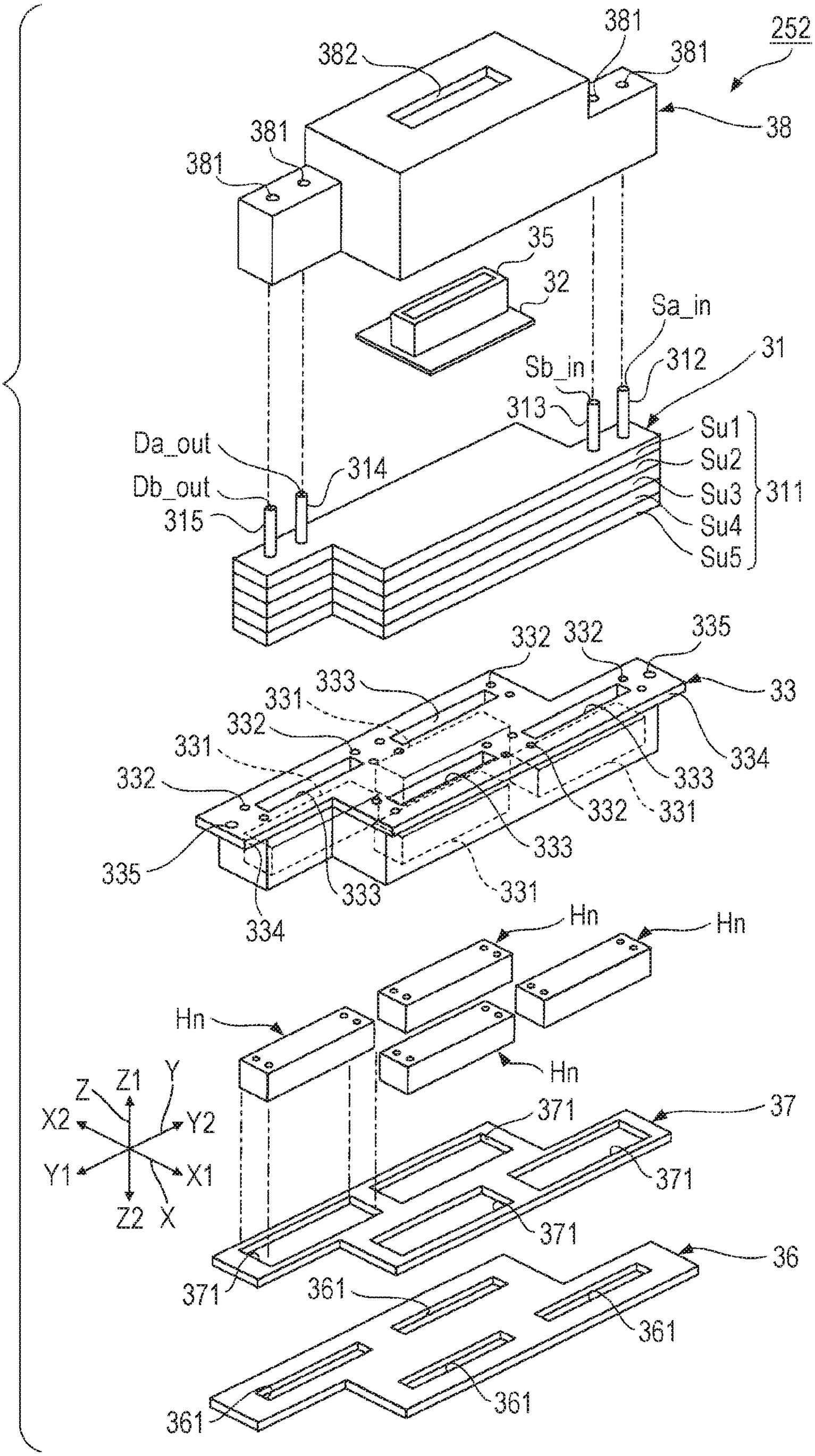
256
252
25
252
Y
Y2
X1
Z1
Z2
Z
X2
Y1
X

FIG. 2

FIG. 3


381
252
382
381
381
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381
35
32
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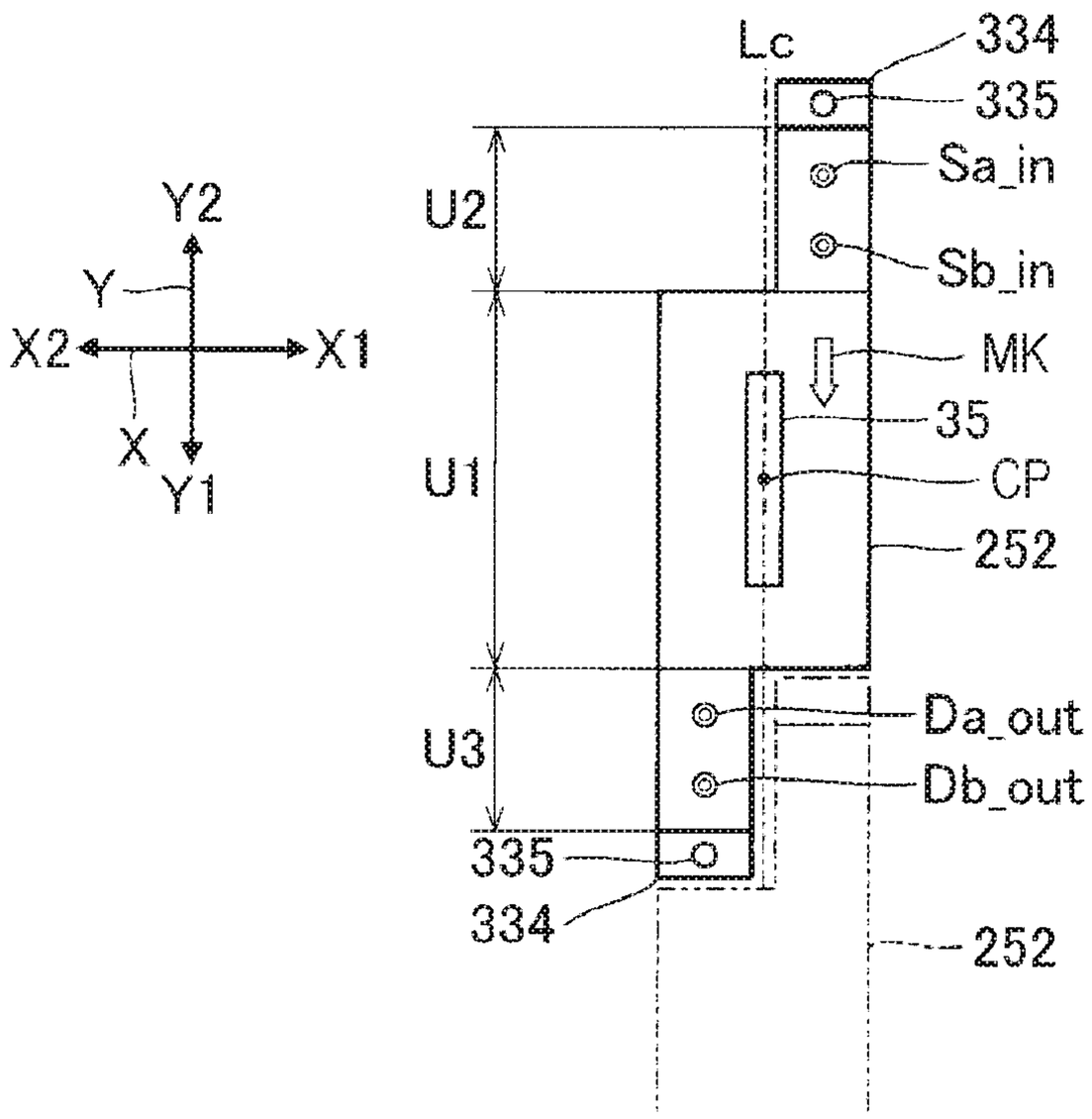
Sb_in
312
31
313
Su1
Su2
Su3
311
Su4
Su5
Da_out
Db_out
314
315
332
332
335
33
333
331
332
331
334
333
332
331
332
335
333
331
334
Hn
Hn
Hn
Hn
Z
Z1
Y
X2
Y2
Y1
X1
Z2
X
371
37
371
371
371
36
361
361
361
361

FIG. 4


Y2
Y
X2
X1
X
Y1
Lc
334
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CP
252
U2
U1
U3
Da_out
Db_out
335
334
252

FIG. 5

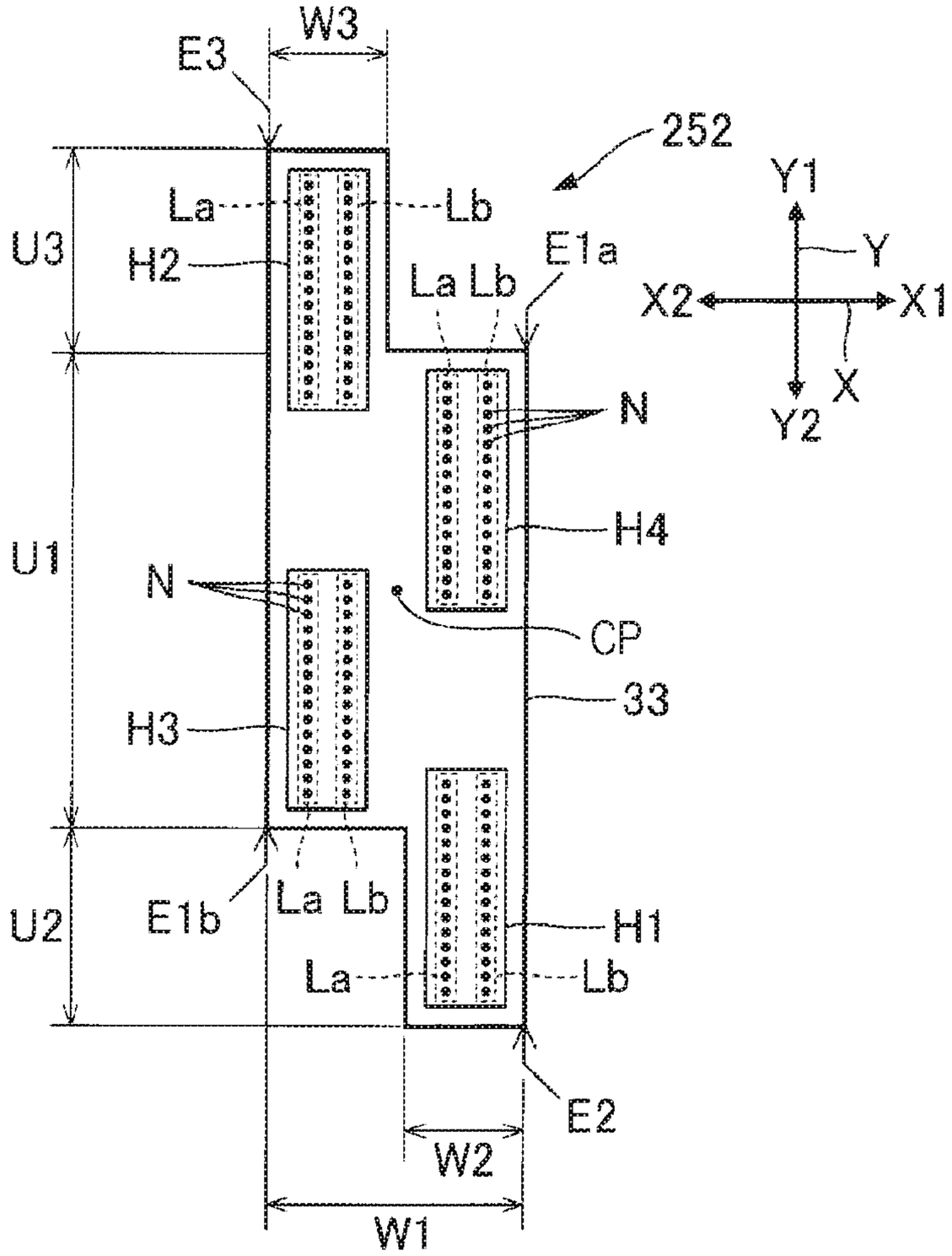

W3
E3
252
Y1
Y
X2
X1
X
Y2
La
Lb
U3
H2
La Lb
E1a
N
H4
U1
N
CP
33
H3
H1
U2
E1b
La Lb
La
Lb
E2
W2
W1

FIG. 6

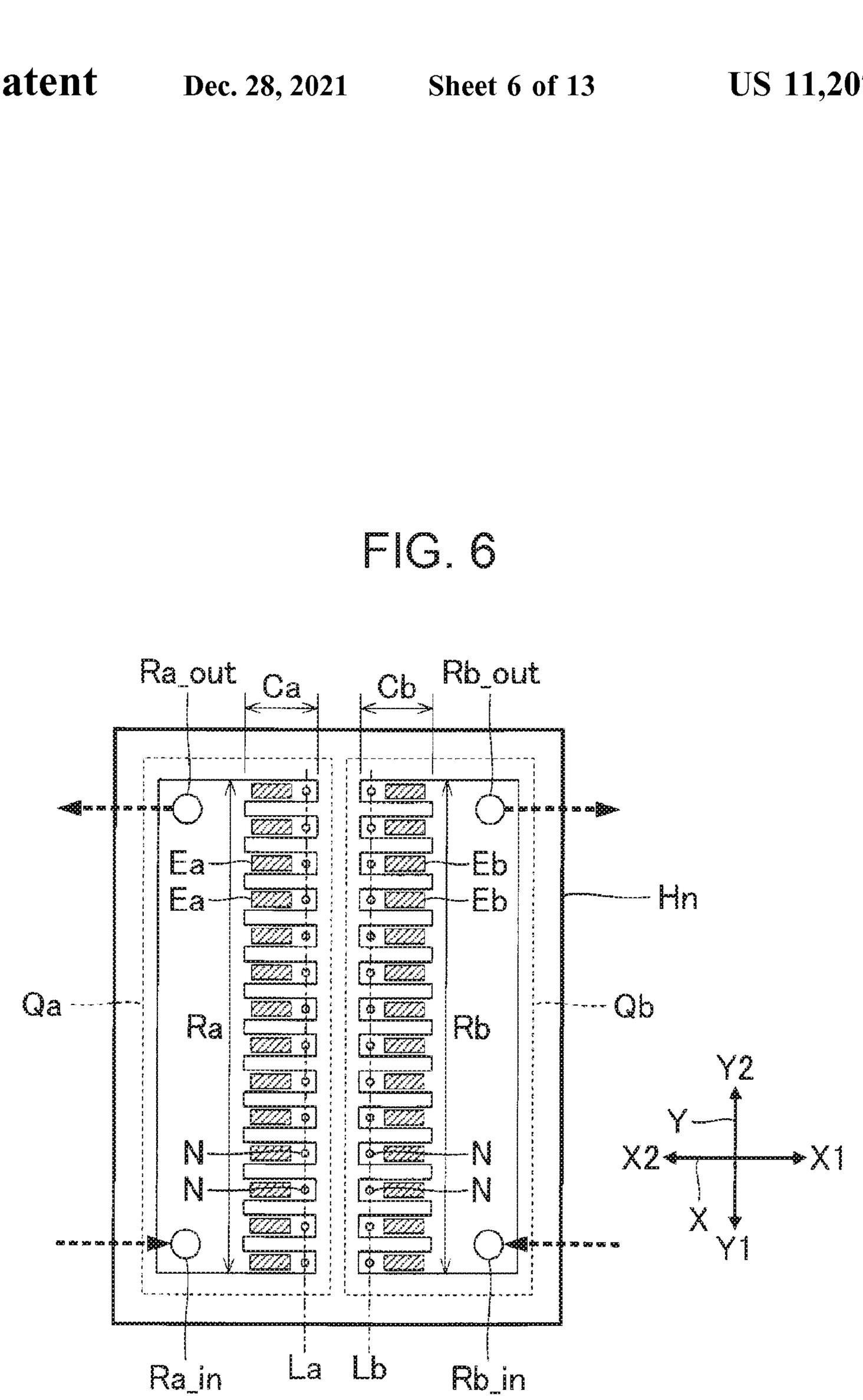

Ra_out
Ca
Cb
Rb_out
Ea
Ea
Eb
Eb
Hn
Qa
Qb
Ra
Rb
N
N
N
N
Y2
Y
X2
X1
X
Y1
Ra_in
La
Lb
Rb_in

FIG. 7

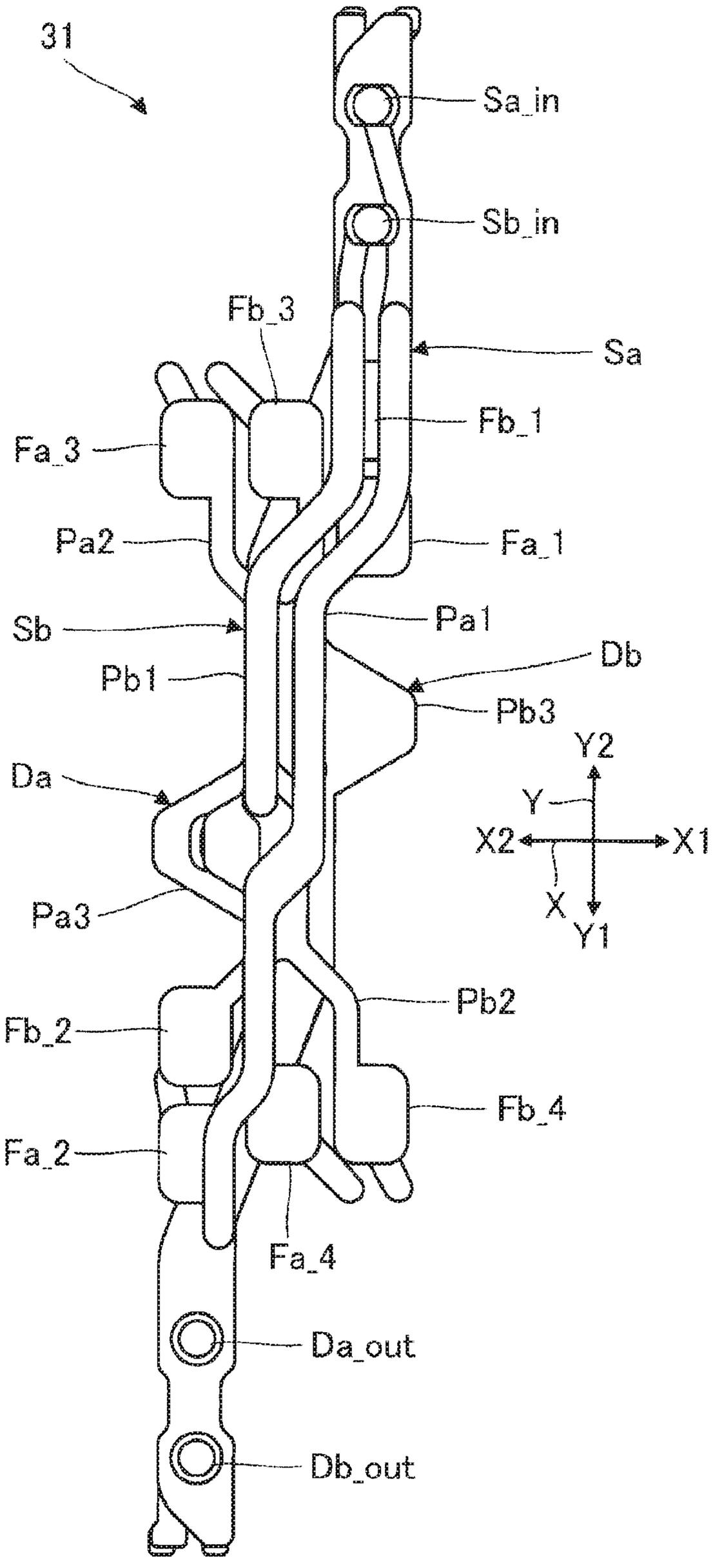

31
Sa_in
Sb_in
Fb_3
Sa
Fb_1
Fa_3
Pa2
Fa_1
Sb
Pa1
Db
Pb1
Pb3
Da
Y2
Y
X2
X1
X
Y1
Pa3
Pb2
Fb_2
Fb_4
Fa_2
Fa_4
Da_out
Db_out

FIG. 8

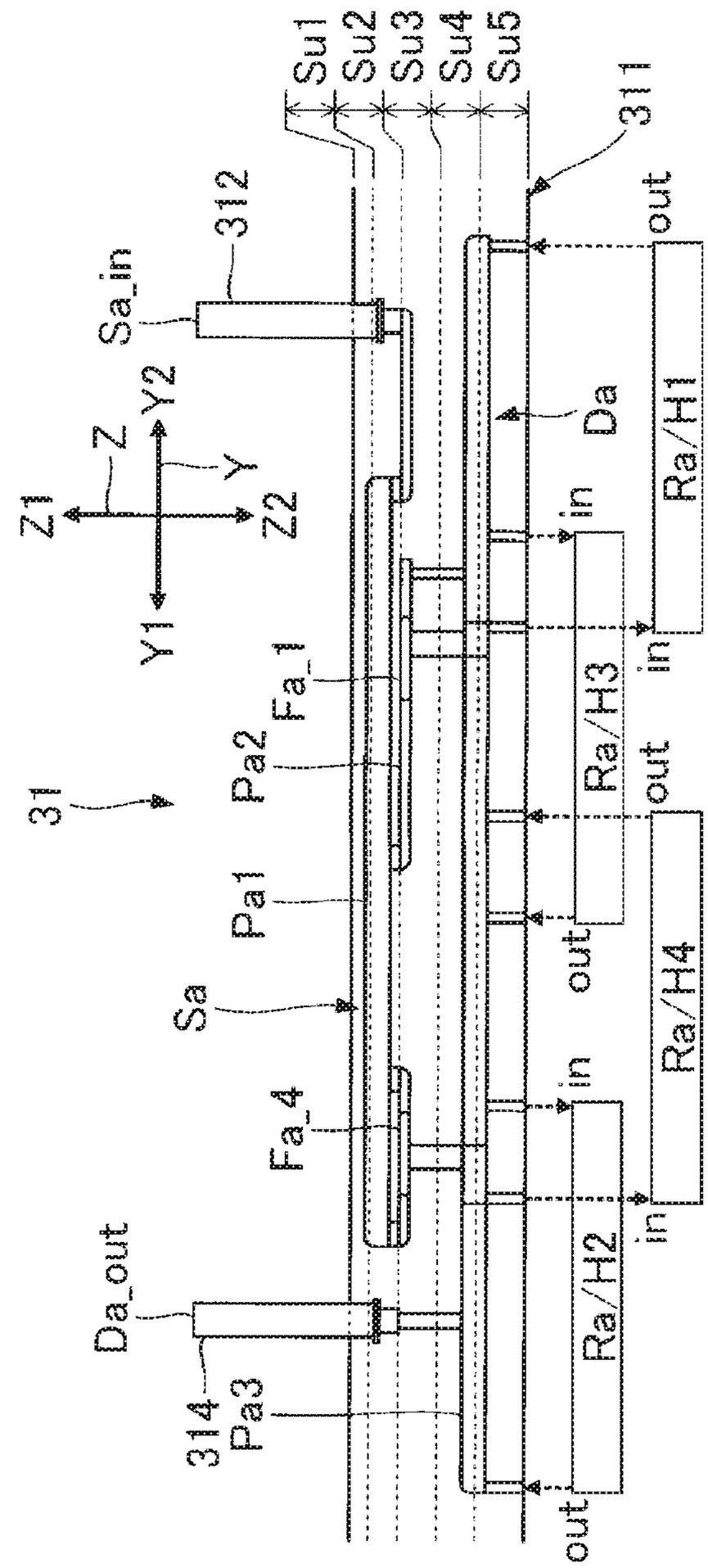

Su1
Su2
Su3
Su4
Su5
311
312
Sa_in
Z1
Z
Y2
Y
Z2
Y1
Da
in
out
Ra/H1
Ra/H3
Ra/H4
Ra/H2
31
Fa_1
Pa2
Pa1
Sa
Fa_4
Da_out
314
Pa3

FIG. 9

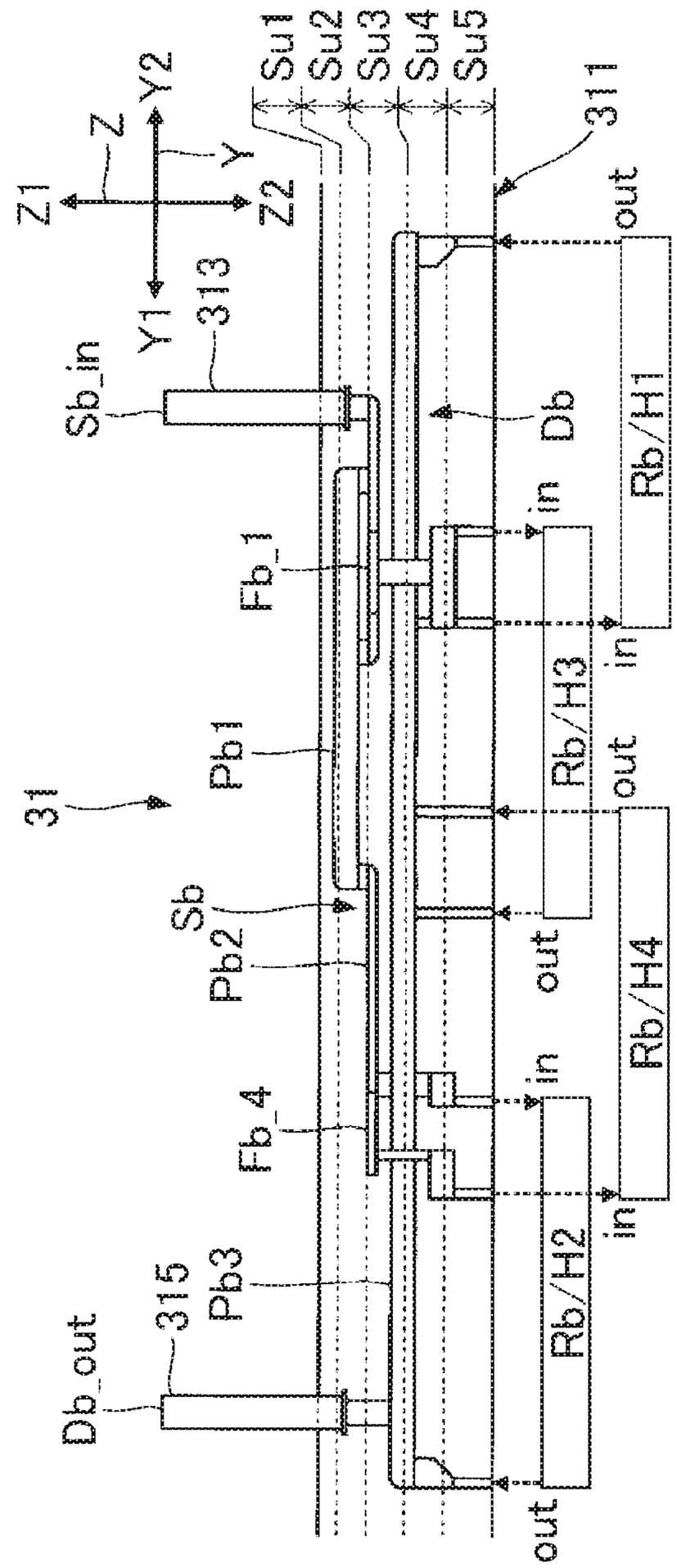

Su1
Su2
Su3
Su4
Su5
311
Z
Y2
Y
Z1
Z2
Y1
313
Sb_in
Db
Fb_1
in
Rb/H1
31
Pb1
Rb/H3
out
in
Sb
Pb2
out
in
Fb_4
Rb/H4
315
Pb3
Db_out
Rb/H2
in
out

FIG. 10

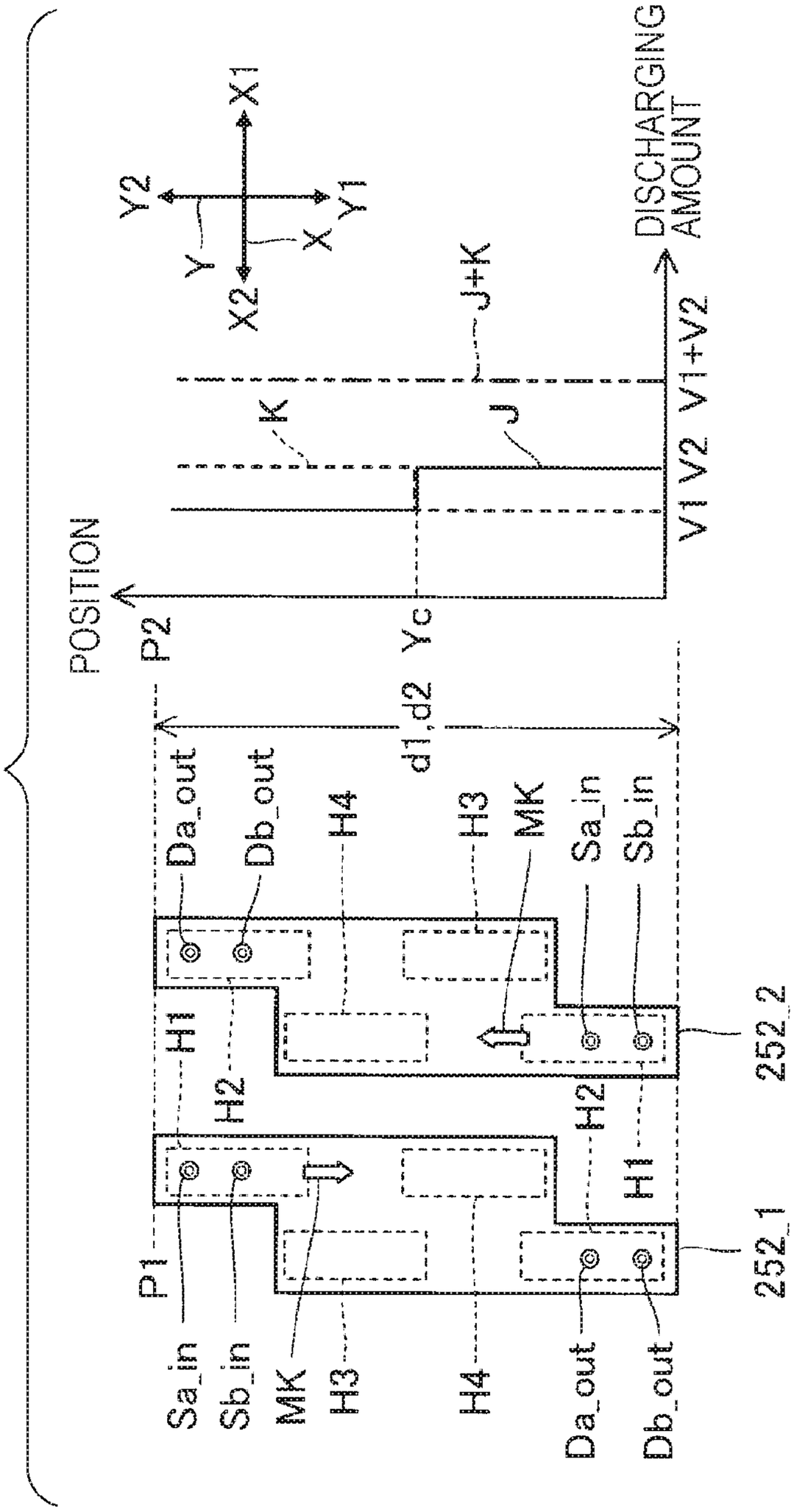

X1
Y2
Y1
X
Y
X2
J+K
DISCHARGING AMOUNT
V1+V2
K
J
V1 V2
POSITION
P2
Yc
d1,d2
Da_out
Db_out
H4
H3
MK
Sa_in
Sb_in
H1
H2
252_2
H2
H1
252_1
P1
Sa_in
Sb_in
MK
H3
H4
Da_out
Db_out

FIG. 11

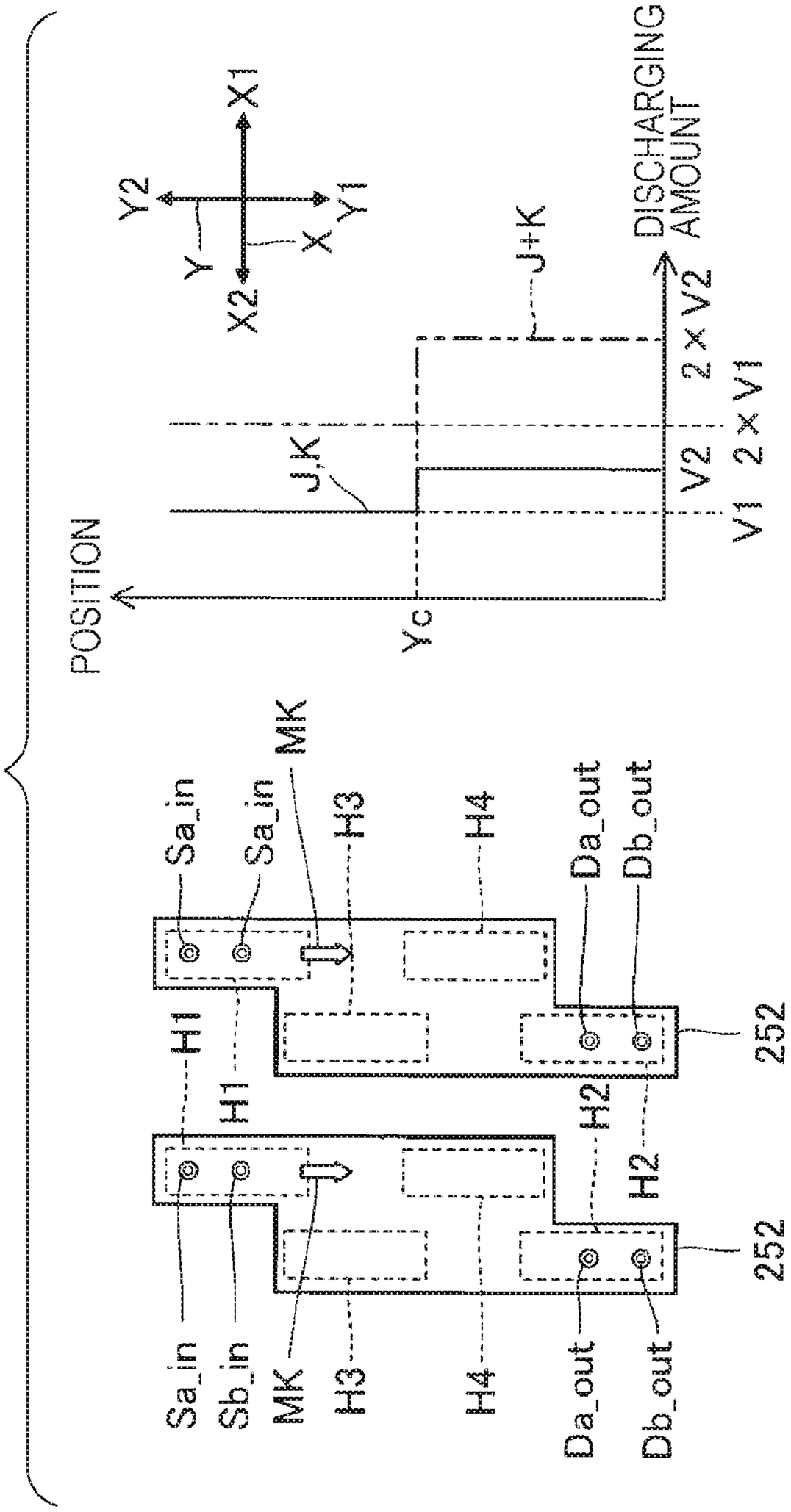
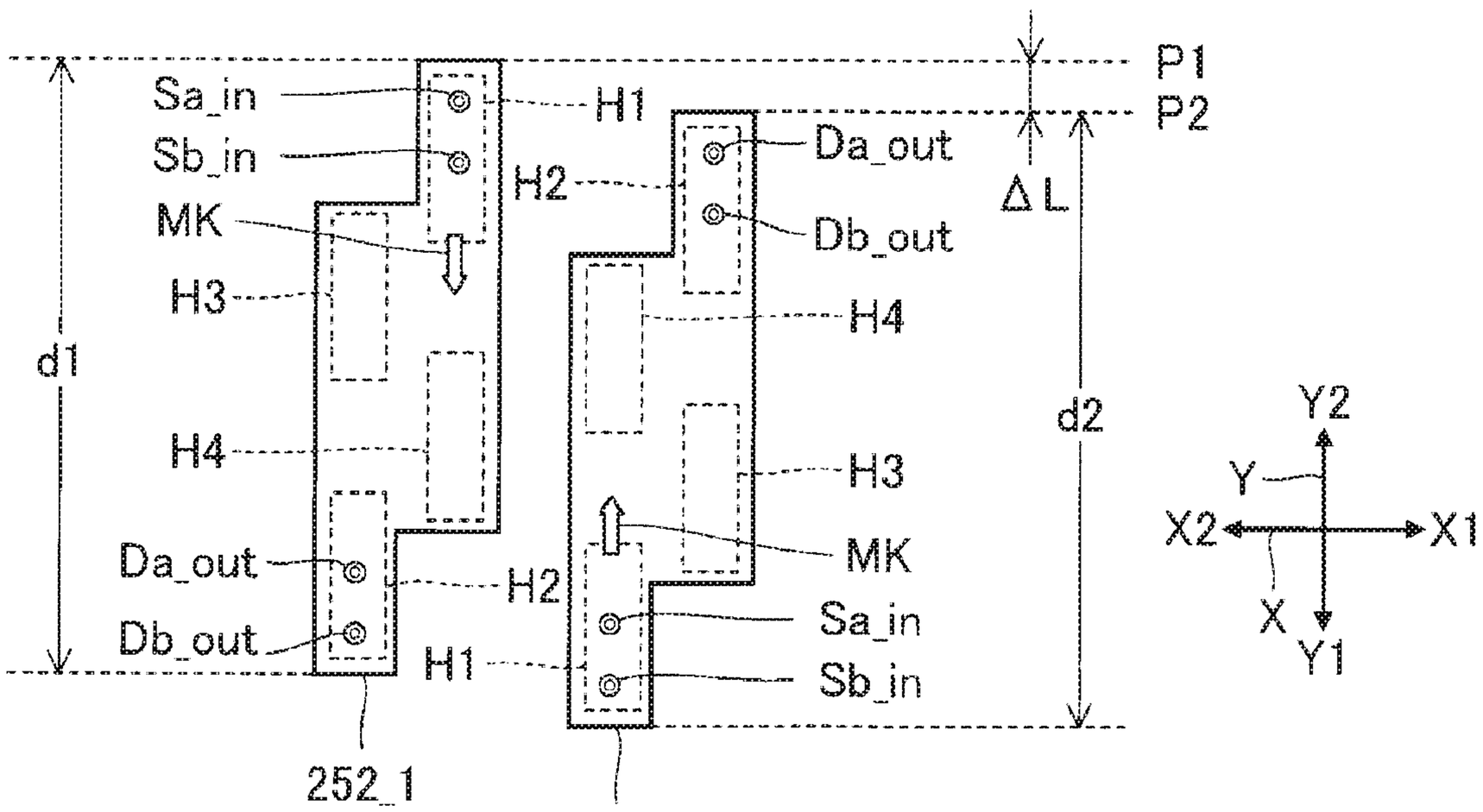

X1
Y2
Y1
X
Y
X2
DISCHARGING AMOUNT
J+K
2 x V2
2 x V1
V2
V1
J,K
POSITION
Yc
Sa_in
Sa_in
MK
H3
H4
Da_out
Db_out
H1
H1
H2
H2
252
252
Sa_in
Sb_in
MK
H3
H4
Da_out
Db_out

FIG. 12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P2
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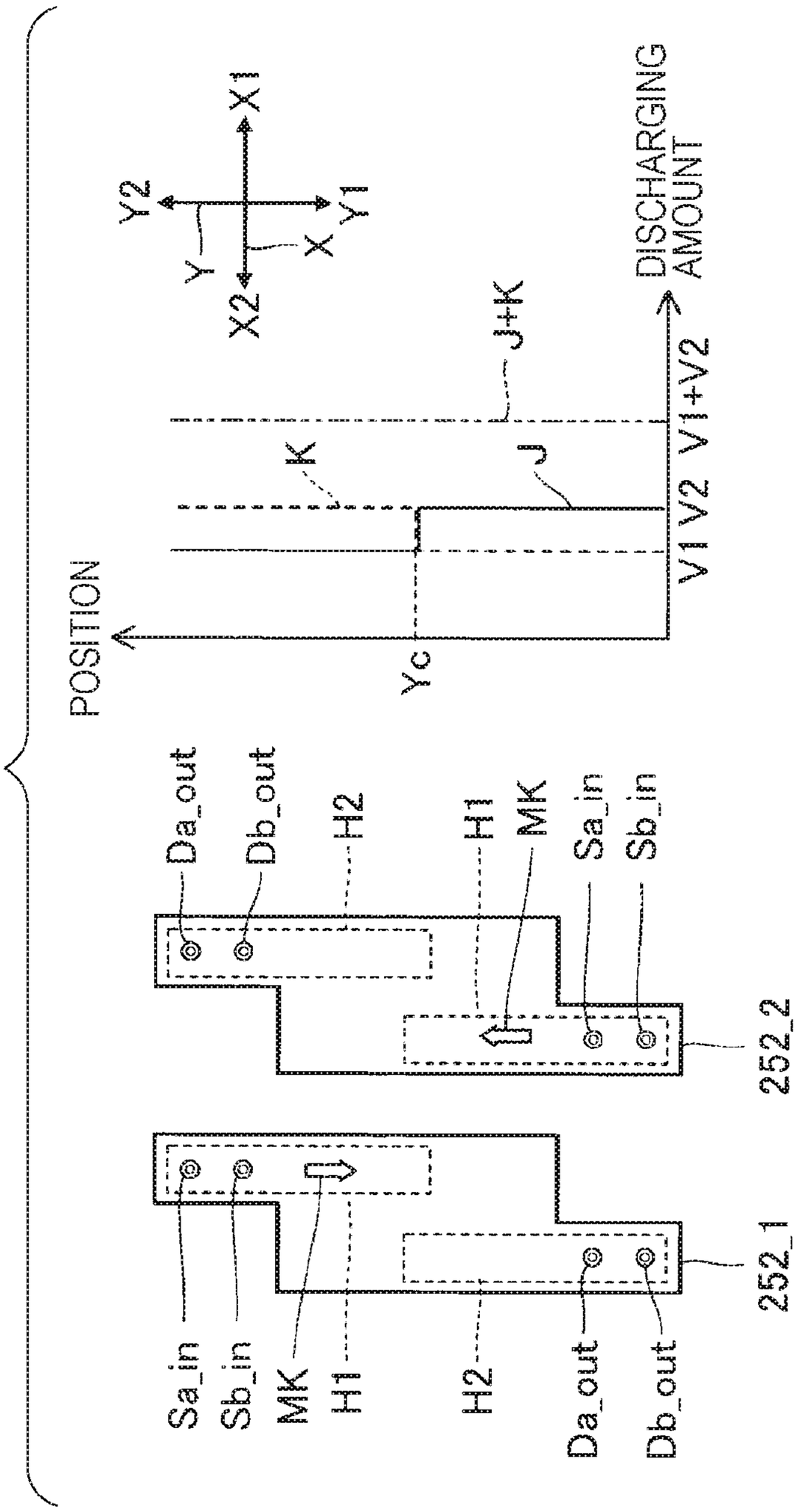
Sa_in
Sb_in
MK
H3
H4
Da_out
Db_out
H1
H2
d1
d2
252_1
252_2
Y2
Y
X2
X1
X
Y1

FIG. 13


X1
Y2
Y1
Y
X
X2
DISCHARGING AMOUNT
J+K
V1+V2
V1 V2
K
J
POSITION
Yc
Da_out
Db_out
H2
H1
MK
Sa_in
Sb_in
252_2
Sa_in
Sb_in
MK
H1
H2
Da_out
Db_out
252_1

LIQUID DISCHARGING APPARATUS

The present application is based on, and claims priority from JP Application Serial Number 2019-156756, filed Aug. 29, 2019, the disclosure of which is hereby incorporated by reference here in its entirety.

BACKGROUND

1. Technical Field

The present disclosure relates to a liquid discharging apparatus.

2. Related Art

In the related art, a liquid discharging apparatus that discharges a liquid such as ink is known, as represented by an ink jet type printer. For example, as disclosed in JP-A-2017-136720, a liquid discharging apparatus of this type generally includes a plurality of liquid discharging heads that discharge a liquid and a flow path member that distributes the liquid to the plurality of liquid discharging heads. Each of the plurality of liquid discharging head is provided with a plurality of nozzles for discharging the liquid. The flow path member is provided with a flow path that supplies a liquid from the outside to the plurality of liquid discharging heads. The flow path includes a plurality of branch flow paths that branch corresponding to the plurality of liquid discharging heads.

It is not easy to make the flow path resistances in the plurality of branch flow paths equal to each other, and as a result, pressure differences of liquid may occur between the plurality of liquid discharging heads. Specifically, when the liquid is circulated inside and outside a unit including the liquid discharging head and the flow path member, the pressure difference is likely to appear as a difference in the discharging amount of the liquid from the nozzles between the plurality of liquid discharging heads. When a plurality of units are arranged and used in a direction intersecting an array direction of the nozzles for the purpose of speeding up printing or high resolution, the plurality of units are disposed in the same direction as each other, in the related art. Therefore, in the related art, there is a problem in that the above-mentioned difference in discharging amount is emphasized by the superposition between the units, and as a result, the printing quality is deteriorated.

SUMMARY

To solve the above problem, according to an aspect of the present disclosure, there is provided a liquid discharging apparatus including: a first head unit provided with a plurality of nozzles that discharge a liquid; and a second head unit provided with a plurality of nozzles that discharge the liquid, in which the first head unit includes a plurality of first nozzles arranged in a first direction, a first flow path communicating with the plurality of first nozzles, a first supply port supplying the liquid from outside the first head unit to the first flow path, and a first exhaust port exhausting the liquid from the first flow path to the outside of the first head unit, the second head unit includes a plurality of second nozzles arranged in the first direction, a second flow path communicating with the plurality of second nozzles, a second supply port supplying the liquid from outside the second head unit to the second flow path, and a second exhaust port exhausting the liquid from the second flow path to the outside of the second head unit, in the first head unit, the first supply port is positioned on a first side, which is one side of the first direction, and the first exhaust port is positioned on a second side, which is the other side of the first direction with respect to a center of the plurality of first nozzles, in the second head unit, the second supply port is positioned on the second side and the second exhaust port is positioned on the first side with respect to a center of the plurality of second nozzles, and the first head unit and the second head unit are arranged in a second direction intersecting with the first direction.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic view illustrating a configuration of a liquid discharging apparatus according to a first embodiment.

FIG. **2** is a perspective view of a head module.

FIG. **3** is a disassembled perspective view of a head unit.

FIG. **4** is a plan view of the head unit as viewed from a **Z1** direction.

FIG. **5** is a plan view of the head unit as viewed from a **Z2** direction.

FIG. **6** is a plan view of a circulation head.

FIG. **7** is a plan view illustrating a flow path provided in a flow path member.

FIG. **8** is a side view of a supply flow path and an exhaust flow path for a first ink among flow paths provided in the flow path member.

FIG. **9** is a side view of a supply flow path and an exhaust flow path for a second ink among flow paths provided in the flow path member.

FIG. **10** is a diagram illustrating a relationship between a position on the Y axis and a discharging amount of liquid for the two head units in the first embodiment.

FIG. **11** is a diagram illustrating a relationship between a position on the Y axis and a discharging amount of liquid for two head units when the head units are disposed in the same direction with each other.

FIG. **12** is a plan view illustrating a disposition of two head units according to a second embodiment.

FIG. **13** is a plan view illustrating a disposition of two head units in a modification example.

DESCRIPTION OF EXEMPLARY EMBODIMENTS

In the following description, an X axis, a Y axis, and a Z axis that are orthogonal to each other are assumed. As illustrated in FIG. **2**, a direction along the X axis when viewed from any point is represented as an X**1** direction, and a direction opposite to the X**1** direction is represented as an X**2** direction. Similarly, directions opposite to each other along the Y axis from any point are represented as Y**1** and Y**2** directions, and directions opposite to each other along the Z axis from any point are represented as Z**1** and Z**2** directions. An X-Y plane including the X axis and the Y axis corresponds to a horizontal plane. The Z axis is an axis along the vertical direction, and the Z**2** direction corresponds to a lower side in the vertical direction. The X axis, the Y axis, and the Z axis may intersect each other at an angle of approximately 90 degrees.

1. First Embodiment

1-1. Liquid Discharging Apparatus **100**

FIG. **1** is a schematic view illustrating a configuration of a liquid discharging apparatus **100** according to a first embodiment. The liquid discharging apparatus **100** is an ink jet type printing apparatus that discharges an ink, which is an example of a liquid, as droplets onto a medium **11**. The medium **11** is typically a printing paper. However, a printing target made of any material such as a resin film or cloth may be used as the medium **11**, for example.

As illustrated in FIG. **1**, the liquid discharging apparatus **100** is provided with a liquid container **12** that stores the ink. For example, a cartridge that is attachable to and detachable from the liquid discharging apparatus **100**, a bag-shaped ink pack made of a flexible film, or an ink tank that can be replenished with an ink is used as the liquid container **12**. As illustrated in FIG. **1**, the liquid container **12** includes a liquid container **12***a* and a liquid container **12***b*. A first ink is stored in the liquid container **12***a*, and a second ink is stored in the liquid container **12***b*. The first ink and the second ink are different types of ink. As an example of the first ink and the second ink, there are cases where the first ink is cyan ink and the second ink is magenta ink.

The liquid discharging apparatus **100** is provided with a sub tank **13** that temporarily stores an ink. The ink supplied from the liquid container **12** is stored in the sub tank **13**. The sub tank **13** includes a sub tank **13***a* that stores the first ink and a sub tank **13***b* that stores the second ink. The sub tank **13***a* is coupled to the liquid container **12***a*, and the sub tank **13***b* is coupled to the liquid container **12***b*. Further, the sub tank **13** is coupled to a head module **25**, supplies ink to the head module **25**, and collects the ink from the head module **25**. The flow of the ink between the sub tank **13** and the head module **25** will be described in detail later.

As illustrated in FIG. **1**, the liquid discharging apparatus **100** includes a control unit **21**, a transporting mechanism **23**, a moving mechanism **24**, and the head module **25**. The control unit **21** controls each element of the liquid discharging apparatus **100**. The control unit **21** includes, for example, one or a plurality of processing circuits such as a central processing unit (CPU) or a field programmable gate array (FPGA), and one or a plurality of storage circuits such as a semiconductor memory.

The transporting mechanism **23** transports a medium **11** along the Y axis under the control of the control unit **21**. The moving mechanism **24** causes the head module **25** to reciprocate along the X axis under the control of the control unit **21**. The moving mechanism **24** according to the present embodiment includes a substantially box-shaped transporting body **241** that accommodates the head module **25**, and an endless belt **242** to which the transporting body **241** is fixed. The liquid container **12** and the sub tank **13** may be mounted on the transporting body **241** together with the head module **25**.

The head module **25** discharges the ink which is supplied from the sub tank **13**, from each of a plurality of nozzles onto the medium **11** under the control of the control unit **21**. The head module **25** discharges the ink onto the medium **11** in parallel with the transport of the medium **11** by the transporting mechanism **23** and the repeated reciprocation of the transporting body **241**, thereby an image is formed on a surface of the medium **11**.

FIG. **2** is a perspective view of the head module **25**. As illustrated in FIG. **2**, the head module **25** includes a support member **251** and a plurality of head units **252**. The support member **251** is a plate-shaped member that supports the plurality of head units **252**. A plurality of mounting holes **253** and a plurality of screw holes **254** are formed in the support member **251**. Each head unit **252** is supported by the support member **251** in a state inserted into the mounting hole **253**. The plurality of screw holes **254** are provided in twos in correspondence with each of the mounting holes **253**. As illustrated in FIG. **2**, each head unit **252** is fixed to the support member **251** by screwing using screws **256** and screw holes **254** at two places. The plurality of head units **252** are arranged in a matrix-shaped along the X axis and the Y axis. However, the number of head units **252** and the aspect of the arrangement of the plurality of head units **252** are not limited to the above example.

1-2. Head Unit **252**

FIG. **3** is a disassembled perspective view of the head unit **252**. As illustrated in FIG. **3**, the head unit **252** includes a flow path member **31**, a wiring substrate **32**, a holder **33**, a plurality of circulation heads Hn, a fixing plate **36**, a reinforcing plate **37**, and a cover **38**. The flow path member **31** is positioned between the wiring substrate **32** and the holder **33**. Specifically, the holder **33** is installed in the Z**2** direction with respect to the flow path member **31**, and the wiring substrate **32** is installed in the Z**1** direction with respect to the flow path member **31**. In the present embodiment, the number of circulation heads Hn provided in each head unit **252** is four. In the following, these four circulation heads Hn are also referred to as circulation heads H**1**, H**2**, H**3**, and H**4**.

The flow path member **31** is a structure having therein a flow path for supplying the ink stored in the sub tank **13** to the plurality of circulation heads Hn. The flow path member **31** includes a flow path structure **311** and connection pipes **312**, **313**, **314**, and **315**. Although not illustrated in FIG. **3**, the flow path structure **311** is provided with a supply flow path for supplying the first ink to the plurality of circulation heads Hn, a supply flow path for supplying the second ink to the plurality of circulation heads Hn, an exhaust flow path for exhausting the first ink from the plurality of circulation heads Hn, and an exhaust flow path for exhausting the second ink from the plurality of circulation heads Hn. The flow path structure **311** is constituted by laminating the plurality of substrates Su**1** to Su**5**. The plurality of substrates Su**1** to Su**5** constituting the flow path structure **311** are formed by injection molding of a resin material, for example. The plurality of substrates Su**1** to Su**5** are bonded to each other by, for example, an adhesive. The flow path structure **311** described above has a longitudinal shape along the Y axis. Connection pipes **312** and **313** are provided in a part at one end of the flow path structure **311** in the longitudinal direction. On the other hand, connection pipes **314** and **315** are provided in a part at the other end of the flow path structure **311** in the longitudinal direction. Each of the connection pipes **312**, **313**, **314**, and **315** is a pipe member protruding from the flow path structure **311**. The connection pipe **312** is a supply pipe provided with a supply port Sa_in for supplying the first ink to the flow path structure **311**. Similarly, the connection pipe **313** is a supply pipe provided with a supply port Sb_in for supplying the second ink to the flow path structure **311**. On the other hand, the connection pipe **314** is an exhaust pipe provided with an exhaust port Da_out for exhausting the first ink from the flow path structure **311**. Similarly, the connection pipe **315** is an exhaust pipe provided with an exhaust port Db_out for exhausting the second ink from the flow path structure **311**.

The wiring substrate **32** is a mounting component for electrically coupling the head unit **252** to the control unit **21**. The wiring substrate **32** is formed of, for example, a flexible

wiring substrate, a rigid wiring substrate, or the like. The wiring substrate **32** is disposed on the flow path member **31**. One surface of the wiring substrate **32** faces the flow path member **31**. A connector **35** is installed on the other surface of the wiring substrate **32**. The connector **35** is a coupling component for electrically coupling the head unit **252** and the control unit **21**. Further, although not illustrated, wirings coupled to the plurality of circulation heads Hn are coupled to the wiring substrate **32**. The wiring is configured with, for example, a combination of a flexible wiring substrate and a rigid wiring substrate. The wiring may be integrated with the wiring substrate **32**.

The holder **33** is a structure that accommodates and supports the plurality of circulation heads Hn. The holder **33** is made of, for example, a resin material or a metal material or the like. The holder **33** is provided with a plurality of recess portions **331**, a plurality of ink holes **332**, a plurality of wiring holes **333**, and a pair of flanges **334**. Each of the plurality of recess portions **331** is a space that opens in the Z**2** direction and in which the circulation head Hn is disposed. Each of the plurality of ink holes **332** is a flow path through which the ink flows between the circulation head Hn disposed in the recess portion **331** and the flow path member **31** described above. Each of the plurality of wiring holes **333** is a hole through which wiring (not shown) that couples the circulation head Hn and the wiring substrate **32** is passed. The pair of flanges **334** is fixing portions for fixing the holder **33** to the support member **251**. The pair of flanges **334** illustrated in FIG. **3** is provided with holes **335** for screwing to the support member **251**. The above-described screw **256** is passed through the hole **335**.

Each circulation head Hn discharges the ink. That is, although not illustrated in FIG. **3**, each circulation head Hn has a plurality of nozzles that discharge the first ink and a plurality of nozzles that discharge the second ink. The configuration of the circulation head Hn will be described later.

The fixing plate **36** is a plate member for fixing the plurality of circulation heads Hn to the holder **33**. Specifically, the fixing plate **36** is disposed so as to sandwich the plurality of circulation heads Hn with the holder **33**, and is fixed to the holder **33** with an adhesive. The fixing plate **36** is made of, for example, a metal material or the like. The fixing plate **36** is provided with a plurality of opening portions **361** for exposing the nozzles of the plurality of circulation heads Hn. In the example of FIG. **3**, the plurality of opening portions **361** are individually provided for each circulation head Hn. The opening portion **361** may be shared by two or more circulation heads Hn.

The reinforcing plate **37** is a plate-shaped member that is disposed between the holder **33** and the fixing plate **36** and reinforces the fixing plate **36**. The reinforcing plate **37** is arranged on the fixing plate **36** in an overlapping manner and fixed to the fixing plate **36** with an adhesive. The reinforcing plate **37** is provided with a plurality of opening portions **371** in which the plurality of circulation heads Hn are disposed. The reinforcing plate **37** is made of, for example, a metal material or the like. From the viewpoint of reinforcing the fixing plate **36**, the thickness of the reinforcing plate **37** is desirably larger than the thickness of the fixing plate **36**.

The cover **38** is a box-shaped member that accommodates the flow path structure **311** of the flow path member **31** and the wiring substrate **32**. The cover **38** is made of, for example, a resin material or the like. The cover **38** is provided with four through holes **381** and an opening portion **382**. The four through holes **381** correspond to the four connection pipes **312**, **313**, **314**, and **315** of the flow path member **31**, and a corresponding connection pipe **312**, **313**, **314**, or **315** is passed through each through hole **381**. The connector **35** is passed through the opening portion **382** from the inside of the cover **38** to the outside.

FIG. **4** is a plan view of the head unit **252** as viewed from the Z**1** direction. As illustrated in FIG. **4**, each head unit **252** is formed with an outer shape that includes a first part U**1**, a second part U**2**, and a third part U**3** when viewed from the Z**1** direction. The first part U**1** is positioned between the second part U**2** and the third part U**3**. Specifically, the second part U**2** is positioned in the Y**2** direction with respect to the first part U**1**, and the third part U**3** is positioned in the Y**1** direction with respect to the first part U**1**. In the present embodiment, each of the flow path member **31** and the holder **33** is formed with an outer shape corresponding to the head unit **252** when viewed from the Z**1** direction. The wiring substrate **32** is formed with an outer shape corresponding to the first part U**1** when viewed from the Z**1** direction.

In FIG. **4**, a center line Lc, which is a line segment passing through a center of the first part U**1** along the Y axis, is illustrated. The second part U**2** is positioned in the X**1** direction with respect to the center line Lc, and the third part U**3** is positioned in the X**2** direction with respect to the center line Lc. That is, the second part U**2** and the third part U**3** are positioned on opposite sides of the X axis with the center line Lc interposed therebetween. As illustrated in FIG. **4**, the plurality of head units **252** are arranged along the Y axis so that the third part U**3** of each head unit **252** and the second part U**2** of the other head unit **252** partially overlap each other along the Y axis.

FIG. **5** is a plan view of the head unit **252** as viewed from the Z**2** direction. In FIG. **5**, the illustration of the pair of flanges **334** is omitted for convenience of description. As illustrated in FIG. **5**, a width W**2** of the second part U**2** along the X axis is shorter than a width W**1** of the first part U**1** along the X axis. Similarly, a width W**3** of the third part U**3** along the X axis is shorter than the width W**1** of the first part U**1** along the X axis. The width W**2** and the width W**3** illustrated in FIG. **4** are equal to each other. The width W**2** and the width W**3** may be different from each other. However, when the width W**2** and the width W**3** are equal to each other, it is possible to increase the symmetry of the shape of the head unit **252**, and as a result, there is an advantage that the plurality of head units **252** can be easily arranged densely. The widths W**1**, W**2**, and W**3** of the first part U**1**, the second part U**2**, and the third part U**3** are the widths between one end and the other end along the X axis of each part.

An end surface Ela of the first part U**1** in the X**1** direction is a plane continuous with an end surface E**2** of the second part U**2** in the X**1** direction. On the other hand, an end surface E**1***b* of the first part U**1** in the X**2** direction is a plane continuous with an end surface E**3** of the third part U**3** in the X**2** direction. A recess portion or a projection portion may be appropriately provided on these end surfaces. Further, a step may be provided between the end surface Ela and the end surface E**2**, and a step may be provided between the end surface E**1***b* and the end surface E**3**.

As illustrated in FIG. **5**, the holder **33** of the head unit **252** holds four circulation heads Hn (n=1 to 4). Each circulation head Hn (n=1 to 4) discharges the ink from a plurality of nozzles N. As illustrated in FIG. **5**, the plurality of nozzles N are divided into a nozzle row La and a nozzle row Lb. Each of the nozzle row La and the nozzle row Lb is a set of the plurality of nozzles N arranged along the Y axis. The nozzle row La and the nozzle row Lb are provided side by side with an interval in the direction of the X axis. In the

following description, the subscript a is added to the reference symbol of the element related to the nozzle row La, and the subscript b is added to the reference symbol of the element related to the nozzle row Lb.

1-3. Circulation Head Hn

FIG. **6** is a plan view of the circulation head Hn. FIG. **6** schematically illustrates the internal structure of the circulation head Hn viewed from the **Z1** direction. As illustrated in FIG. **6**, each circulation head Hn includes a liquid discharging portion Qa and a liquid discharging portion Qb. The liquid discharging portion Qa of each circulation head Hn discharges the first ink supplied from the sub tank **13***a* from each nozzle N of the nozzle row La. The liquid discharging portion Qb of each circulation head Hn discharges the second ink supplied from the sub tank **13***b* from each nozzle N of the nozzle row Lb.

The liquid discharging portion Qa includes a liquid storage chamber Ra, a plurality of pressure chambers Ca, and a plurality of driving elements Ea. The liquid storage chamber Ra is a common liquid chamber that is continuous over the plurality of nozzles N of the nozzle row La. The pressure chamber Ca and the driving element Ea are formed for each nozzle N of the nozzle row La. The pressure chamber Ca is a space for communicating with the nozzle N. Each of the plurality of pressure chambers Ca is filled with the first ink supplied from the liquid storage chamber Ra. The driving element Ea changes the pressure of the first ink inside the pressure chamber Ca. For example, a piezoelectric element that changes the volume of the pressure chamber Ca by deforming the wall surface of the pressure chamber Ca or a heat generating element that generates bubbles inside the pressure chamber Ca by heating the first ink inside the pressure chamber Ca is desirably utilized as the driving element Ea. The driving element Ea changes the pressure of the first ink in the pressure chamber Ca, and thus the first ink inside the pressure chamber Ca is discharged from the nozzle N.

The liquid discharging portion Qb includes a liquid storage chamber Rb, a plurality of pressure chambers Cb, and a plurality of driving elements Eb, like the liquid discharging portion Qa. The liquid storage chamber Rb is a common liquid chamber that is continuous over the plurality of nozzles N of the nozzle row Lb. The pressure chamber Cb and the driving element Eb are formed for each nozzle N of the nozzle row Lb. Each of the plurality of pressure chambers Cb is filled with the second ink supplied from the liquid storage chamber Rb. The driving element Eb is, for example, the above-described piezoelectric element or heat generating element. The driving element Eb changes the pressure of the second ink inside the pressure chamber Cb, and thus the second ink inside the pressure chamber Cb is discharged from the nozzle N.

As illustrated in FIG. **6**, each circulation head Hn is provided with a supply port Ra_in, an exhaust port Ra_out, a supply port Rb_in, and an exhaust port Rb_out. The supply port Ra_in and the exhaust port Ra_out communicate with the liquid storage chamber Ra. The supply port Rb_in and the exhaust port Rb_out communicate with the liquid storage chamber Rb.

The first ink, among the first ink stored in the liquid storage chamber Ra of each circulation head Hn described above, that is not discharged from each nozzle N of the nozzle row La circulates in the path of the exhaust port Ra_out→the exhaust flow path for the first ink of the flow path member **31**→the sub tank **13***a* provided outside the head unit **252**→the supply flow path for the first ink of the flow path member **31**→the supply port Ra_in →the liquid storage chamber Ra. Similarly, the second ink, among the second ink stored in the liquid storage chamber Rb of each circulation head Hn, that is not discharged from each nozzle N of the nozzle row Lb circulates in the path of the exhaust port Rb_out→the exhaust flow path for the second ink of the flow path member **31**→the sub tank **13***b* provided outside the head unit **252**→the supply flow path for the second ink of the flow path member **31**→the supply port Rb_in →the liquid storage chamber Rb.

1-4. Flow Path Member **31**

FIG. **7** is a plan view illustrating a flow path provided in a flow path member **31**. FIG. **8** is a side view of a supply flow path Sa and an exhaust flow path Da for the first ink among flow paths provided in the flow path member **31**. FIG. **9** is a side view of a supply flow path Sb and an exhaust flow path Db for the second ink among flow paths provided in the flow path member **31**. In FIGS. **8** and **9**, the liquid storage chamber Ra of each circulation head Hn is represented by a symbol "Ra/Hn", and the liquid storage chamber Rb of each circulation head Hn is represented by a symbol "Rb/Hn". The configuration of the flow path in the flow path member **31** is not limited to the following configuration.

Inside the flow path member **31**, as illustrated in FIG. **7**, the supply flow path Sa, the exhaust flow path Da, the supply flow path Sb, and the exhaust flow path Db are provided. The supply flow path Sa is a flow path from the supply port Sa_in to the liquid storage chamber Ra of each circulation head Hn. The exhaust flow path Da is a flow path from the liquid storage chamber Ra of each circulation head Hn to the exhaust port Da_out. The supply flow path Sb is a flow path from the supply port Sb_in to the liquid storage chamber Rb of each circulation head Hn. The exhaust flow path Db is a flow path from the liquid storage chamber Rb of each circulation head Hn to the exhaust port Da_out.

As illustrated in FIGS. **7** and **8**, the supply flow path Sa is a flow path that includes a supply portion Pa**1**, a connection portion Pa**2**, and four filter portions Fa_**1** to Fa_**4**. As illustrated in FIG. **8**, the supply portion Pa**1** is formed between the first substrate Su**1** and the second substrate Su**2**. The supply portion Pa**1** has a shape extending along the Y axis. The supply port Sa_in communicates with the end of the supply portion Pa**1** in the Y**2** direction.

The connection portion Pa**2** and the four filter portions Fa_**1** to Fa_**4** are formed between the second substrate Su**2** and the third substrate Su**3**. Each of the filter portions Fa_**1** to Fa_**4** is provided with a filter that collects foreign matter or bubbles mixed in the first ink. The connection portion Pa**2** communicates with the supply portion Pa**1** through a through hole formed at the second substrate Su**2**. The connection portion Pa**2** extends in the Y**2** direction from a connection position with the supply portion Pa**1** and branches into two systems to communicate with the filter portion Fa_**1** and the filter portion Fa_**3**.

The filter portion Fa_**2** communicates with the supply portion Pa**1** through a through hole formed at the second substrate Su**2**. The filter portion Fa_**4** communicates with the supply portion Pa**1** through a through hole formed at the second substrate Su**2**. Each of the filter portions Fa_**1** to Fa_**4** communicates with the supply port Ra_in of each circulation head Hn through a through hole that penetrates the third substrate Su**3**, the fourth substrate Su**4**, and the fifth substrate Su**5**.

As illustrated in FIG. **7** and FIG. **9**, the supply flow path Sb is a flow path that includes the supply portion Pb**1**, the connection portion Pb**2**, and the four filter portions Fb_**1** to Fb_**4**. The supply portion Pb**1** is formed between the first substrate Su**1** and the second substrate Su**2**. The supply

portion Pb1 has a shape extending along the Y axis. The supply port Sb_in communicates with the end of the supply portion Pb1 in the Y2 direction. The supply portion Pa1 and the supply portion Pb1 are provided side by side between the first substrate Su1 and the second substrate Su2.

The connection portion Pb2 and the four filter portions Fb_1 to Fb_4 are formed between the second substrate Su2 and the third substrate Su3. Each of the filter portions Fb_1 to Fb_4 is provided with a filter that collects foreign matter or bubbles mixed in the second ink. The connection portion Pb2 communicates with the supply portion Pb1 through a through hole formed at the second substrate Su2. The connection portion Pb2 extends in the Y1 direction from a connection position with the supply portion Pb1 and branches into two systems to communicate with the filter portion Fb_2 and the filter portion Fb_4. The connection portion Pb2 extends from the connection position with the supply portion Pb1 in the direction opposite to the connection portion Pa2.

The filter portion Fb_1 communicates with the supply portion Pb1 through a through hole formed at the second substrate Su2. The filter portion Fb_3 communicates with the supply portion Pb1 through a through hole formed at the second substrate Su2. Each of the filter portions Fb_1 to Fb_4 communicates with the supply port Rb_in of each circulation head Hn through a through hole that penetrates the third substrate Su3, the fourth substrate Su4, and the fifth substrate Su5.

As illustrated in FIGS. 7 and 8, the exhaust flow path Da is a flow path that includes an exhaust portion Pa3. The exhaust portion Pa3 is formed between the fourth substrate Su4 and the fifth substrate Su5. The exhaust portion Pa3 has a shape extending along the Y axis over a wider range than the supply portion Pa1. The vicinity of the end portion of the exhaust portion Pa3 in the Y1 direction communicates with the exhaust port Da_out. The exhaust port Ra_out of each circulation head Hn communicates with the exhaust portion Pa3 through a through hole that penetrates the fifth substrate Su5.

As illustrated in FIGS. 7 and 9, the exhaust flow path Db is a flow path that includes the exhaust portion Pb3. The exhaust portion Pb3 is formed between the third substrate Su3 and the fourth substrate Su4. The exhaust portion Pb3 has a shape extending along the Y axis over a wider range than the supply portion Pb1. The vicinity of the end portion of the exhaust portion Pb3 in the Y1 direction communicates with the exhaust port Db_out. The exhaust port Rb_out of each circulation head Hn communicates with the exhaust portion Pb3 through a through hole that penetrates the fourth substrate Su4 and the fifth substrate Su5.

1-5. Variations of Discharging Amount in Head Unit 252

When the head unit 252 as described above is used, the circulation heads Hn provided in one head unit 252 may cause variations in the discharging amount of ink. More specifically, among the liquid circulation heads H1 to H4, there is a difference between the discharging amounts of the liquid from the circulation heads H1 and H3, and the discharging amounts of the liquid from the circulation heads H2 and H4. It is considered that this is due to the difference in the configuration of the flow paths in the flow path member 31.

For example, as can be seen from FIGS. 7 to 9, the ink flowing through the supply flow path Sa is supplied from the supply port Sa_in and then travels in the supply portion Pa1 in the Y1 direction along the Y axis. After that, the ink flows from the supply portion Pa1 toward the circulation heads H1 and H3 through the flow path branched in the Z2 direction in the vicinity of the connection portion Pa2. At this time, immediately after passing through the vicinity of the connection portion Pa2, the ink flows in the Y2 direction, that is, in the direction opposite to that when flowing in the supply portion Pa1.

On the other hand, the ink that does not flow toward the circulation heads H1 and H3 continues further toward the Y1 direction, and then flows to the circulation heads H2 and H4. As described above, in the circulation heads H1 and H3, and the circulation heads H2 and H4, the flow path resistance, the direction of the ink flow, the length of the flow path, and the like are completely different until when the liquid reaches each circulation head Hn from the supply port Sa_in. As a result, even when the same drive signal is input to the one driving element Ea, Eb in each circulation head Hn, a difference occurs in the discharging amount of the ink from the nozzle N corresponding to the one driving element Ea, Eb between the circulation heads H1 and H3, and the circulation heads H2 and H4.

1-6. Disposition of Head Unit 252

FIG. 10 is a diagram illustrating a relationship between a position on the Y axis and a discharging amount of ink for the two head units 252 in the first embodiment. In the following description, when referring to the discharging amount of the ink, it is assumed that a certain one and the same drive signal is input, unless otherwise specified. Further, in the following description, a case where the discharging amount of the ink in the circulation heads H1 and H3 is smaller than the discharging amount of the ink in the circulation heads H2 and H4 is illustrated.

In FIG. 10, among the plurality of head units 252 supported by the support member 251, the two head units 252 arranged along the X axis are representatively illustrated as head units 252_1 and 252_2. The head unit 252_1 is an example of a first head unit, and the head unit 252_2 is an example of a second head unit. In the present embodiment, a position P1 of the head unit 252_1 coincides with a position P2 of the head unit 252_2 in the Y1 direction or the Y2 direction.

Although not illustrated, the plurality of head units 252 included in the liquid discharging apparatus 100 are configured by combining a plurality of sets of head units 252_1 and 252_2. However, one or both of the head units 252_1 and 252_2 forming another set may be interposed between the head unit 252_1 and the head unit 252_2 forming a set.

As illustrated in FIG. 10, the head units 252_1 and 252_2 are disposed opposite to each other on the Y axis.

FIG. 10 illustrates that a change J in discharging amount of the ink from each nozzle of the head unit 252_1 on the Y axis, a change K in discharging amount of the ink from each nozzle of the head unit 252_2 on the Y axis, and a change J+K in total discharging amount of the ink from each nozzle of the head units 252_1 and 252_2 on the Y axis.

As described above, in the head unit 2521, a discharging amount V2 from the circulation heads H2 and H4 is larger than a discharging amount V1 from the circulation heads H1 and H3. Therefore, in the head unit 2521, as indicated in the change J in discharging amount in FIG. 10, the discharging amount V2 is illustrated on the Y1 side from the center Yc of the Y axis, and the discharging amount V1 is illustrated on the Y2 side from the center Yc of the Y axis, thereby at the center Yc of the Y axis, an increase in the discharging amount of V2−V1 occurs from the Y2 side to the Y1 side.

On the other hand, in the head unit 252_2, the discharging amount from the circulation heads H1 to H4 is the same as that of the head unit 2521, but the head unit 252_1 is disposed in the opposite direction to the Y axis. That is, the

circulation head H2 of the head unit **252_2** corresponds to a region on the medium **11** to which the circulation head H1 of the head unit **252_1** corresponds, and the circulation head H3 of the head unit **252_2** corresponds to a region on the medium **11** to which the circulation head H4 of the head unit **252_1** corresponds. Therefore, as indicated in the change K in discharging amount in FIG. **10**, the discharging amount V1 is illustrated on the Y1 side from the center Yc of the Y axis, and the discharging amount V2 is illustrated on the Y2 side from the center Yc of the Y axis, thereby at the center Yc of the Y axis, a decrease in the discharging amount of V2−V1 occurs from the Y2 side to the Y1 side.

As a result, as indicated in the change J+K in total discharging amount in FIG. **10**, the total discharging amount is equal to V1+V2 regardless of the position of the Y axis. Therefore, in an image printed on the medium **11**, there is no difference in density at the center Yc of the Y axis, and the image quality is less likely to deteriorate.

Reference Example

FIG. **11** is a diagram illustrating a relationship between a position on the Y axis and a discharging amount of ink for the two head units **252** in Reference Example. As illustrated in FIG. **11**, the two head units **252** are disposed in the same direction as each other.

In this case, in the head unit **252_1** and the head unit **252_2**, the circulation head Hn having the same discharging amount corresponds to the same region on the medium **11**. That is, the circulation head H1 of the head unit **252_2** corresponds to a region on the medium **11** to which the circulation head H1 of the head unit **252_1** corresponds, and the circulation head H4 of the head unit **252_2** corresponds to a region on the medium **11** to which the circulation head H4 of the head unit **252_1** corresponds. Therefore, in both head unit **252_1** and head unit **252_2**, as indicated in the change K in discharging amount and in the change J in discharging amount in FIG. **11**, the discharging amount V2 is illustrated on the Y1 side from the center Yc of the Y axis, and the discharging amount V1 is illustrated on the Y1 side from the center Yc of the Y axis, thereby at the center Yc of the Y axis, an increase in the discharging amount of V2−V1 occurs from the Y2 side to the Y1 side.

As a result, as indicated in the change J+K in discharging amount in FIG. **11**, 2×V1 is obtained on the Y2 side from the center Yc of the Y axis and 2×V2 is obtained on the Y1 side from the center Yc of the Y axis. Therefore, in an image printed on the medium **11**, a large difference in density of 2×V2−2×V1 occurs at the center Yc of the Y axis, and the image quality is greatly deteriorated.

In the plurality of head units **252** included in the liquid discharging apparatus **100**, there are a plurality of head units **252** disposed in the same direction as each other, and the same number of head units **252** are disposed so as to have the relationship illustrated in FIG. **10**.

As can be understood from the above, the liquid discharging apparatus **100** has head units **252_1** and **252_2** provided with a plurality of nozzles N that discharge ink, which is an example of a liquid, and the head unit **252_1** corresponds to "a first head unit", and the head unit **252_2** corresponds to "a second head unit".

Each of the head units **252_1** and **252_2** includes a plurality of nozzles N in nozzle rows La and Lb, supply flow paths Sa and Sb, exhaust flow paths Da and Db, supply ports Sa_in and Sb_in, and exhaust ports Da_out and Db_out. The plurality of nozzles N in each of the nozzle rows La and Lb are arranged in the Y1 direction or the Y2 direction. The supply flow path Sa and the exhaust flow path Da communicate with the plurality of nozzles N of the nozzle row La. The supply flow path Sb and the exhaust flow path Db communicate with the plurality of nozzles N of the nozzle row Lb. The supply port Sa_in supplies the ink to the supply flow path Sa from outside the head units **252_1** and **252_2**. The supply port Sb_in supplies the ink to the supply flow path Sb from outside the head units **252_1** and **252_2**. The exhaust port Da_out exhausts the ink from the exhaust flow path Da to the outside of the head units **252_1** and **252_2**. The exhaust port Db_out exhausts the ink from the exhaust flow path Db to the outside of the head units **252_1** and **252_2**.

Further, the head units **252_1** and **252_2** are disposed opposite to each other. That is, in the head unit **2521**, the supply ports Sa_in and Sb_in are positioned in the Y2 direction and the exhaust ports Da_out and Db_out are positioned in the Y1 direction with respect to the center CP of the plurality of nozzles N. In contrast to this, in the head unit **252_2**, the supply ports Sa_in and Sb_in are positioned in the Y1 direction and the exhaust ports Da_out and Db_out are positioned in the Y2 direction with respect to the center CP of the plurality of nozzles N. Thereafter, the head units **252_1** and **252_2** are arranged in the X1 direction or the X2 direction. "a center CP of a plurality of nozzles N" means the geometric center of gravity of the aggregate of the plurality of nozzles N, as illustrated in FIG. **5**.

In the liquid discharging apparatus **100**, by disposing the head units **252_1** and **252_2** in opposite directions, the difference in ink discharging amount between the circulation heads Hn of the head unit **252_1** and the difference in ink discharging amount between the circulation heads Hn of the head unit **252_2** can be canceled out or reduced. Therefore, it is possible to reduce the deterioration of the printing quality due to the difference in ink discharging amount between the circulation heads Hn of each of the head units **252_1** and **252_2**. Hereinafter, the effect, in which the difference in ink discharging amount between the circulation heads Hn of the head unit **252_1** and the difference in ink discharging amount between the circulation heads Hn of the head unit **252_2** can be canceled out or reduced, is also referred to as the "discharging unevenness reducing effect".

The Y1 direction or the Y2 direction corresponds to "a first direction". The Y2 direction corresponds to "a first side" that is one side of the Y1 direction or the Y2 direction, and the Y1 direction corresponds to "a second side" that is the other side of the Y1 direction or the Y2 direction. The X1 direction or the X2 direction corresponds to "a second direction" intersecting the Y1 direction or the Y2 direction.

Further, each of the plurality of nozzles N included in the head unit **252_1** corresponds to "a first nozzle". Each of the flow path constituted by the supply flow path Sa and the exhaust flow path Da, and the flow path constituted by the supply flow path Sb and the exhaust flow path Db, which are included in the head unit **252_1**, corresponds to "a first flow path". Each of the supply ports Sa_in and Sb_in included in the head unit **252_1** corresponds to "a first supply port". Each of the exhaust ports Da_out and Db_out included in the head unit **252_1** corresponds to "a first exhaust port". On the other hand, each of the plurality of nozzles N included in the head unit **252_2** corresponds to "a second nozzle". Each of the flow path constituted by the supply flow path Sa and the exhaust flow path Da, and the flow path constituted by the supply flow path Sb and the exhaust flow path Db, which are included in the head unit **2522**, corresponds to "a second flow path". Each of the supply ports Sa_in and Sb_in included in the head unit **252_2** corresponds to "a second

supply port". Each of the exhaust ports Da_out and Db_out included in the head unit **252_2** corresponds to "a second exhaust port".

In the present embodiment, a position P**1** of the head unit **252_1** coincides with a position P**2** of the head unit **252_2** in the Y**1** direction or the Y**2** direction. Therefore, the disposition density of the nozzles N in the X**1** direction or the X**2** direction can be increased, and as a result, the printing speed can be increased.

Further, as described above, the liquid discharging apparatus **100** further includes the support member **251** that supports the head unit **252_1**. The head unit **252_1** has a pair of flanges **334**. Of the pair of flanges **334**, one flange **334** corresponds to "a first fixing portion" that is capable of fixing the head unit **252_1** to the support member **251** in a first posture, and the other flange **334** corresponds to "a second fixing portion" that is capable of fixing the head unit **252_1** to the support member **251** in a second posture that is different from the first posture. In the present embodiment, the first posture and the second posture are the postures in which the mounting postures of the head unit **252_1** with respect to the support member **251** are 180° different from each other in the XY plane. In this way, the head unit **252_1** is configured so that the mounting posture with respect to the support member **251** can be selected from the first posture and the second posture. Therefore, the head units **252_1** and **252_2** can have the same configuration. As a result, the cost reduction of the liquid discharging apparatus **100** can be achieved as compared with the case where the head units **252_1** and **252_2** have different configurations.

Each of the pair of flanges **334** is provided with a hole **335** for screwing. In contrast to this, the support member **251** has a pair of screw holes **254** corresponding to the pair of holes **335**. Of the pair of screw holes **254**, one screw hole **254** corresponds to "a first screwing portion" to which the flange **334** is screwed in the above-described first posture, and corresponds to "a second screwing portion" to which the flange **334** is screwed in the above-described second posture. In this way, by sharing the screw holes **254** in the first posture and the second posture, the configuration of the support member **251** can be simplified as compared with the case where the flange **334** is fixed to the support member **251** using different screw holes in the first posture and the second posture.

As illustrated in FIGS. **4** and **10**, the head unit **252_1** is provided with an identification portion MK that can identify whether the supply port Sa_in is positioned in the Y**2** direction with respect to the center CP. Therefore, even when the head units **252_1** and **252_2** have the same configuration, it is easy to attach the head unit **252_1** to the support member **251** by selecting from the first posture and the second posture. The identification portion MK illustrated in FIG. **4** is an indication indicating a flowing direction of the first ink from the supply port Sa_in to the exhaust port Da_out or a flow direction of the second ink from Sb_in to the exhaust port Db_out. This indication is configured with, for example, a stamp, a print, a sticker, or the like. The indication form such as an indication position or indication content of the identification portion MK is not limited to the example in FIG. **4**. For example, the identification portion MK may be an indication indicating that the connection pipe **312** or **313** is the supply port Sa_in or Sb_in, or an indication indicating that the connection pipe **314** or **315** is the exhaust port Da_out or Db_out, or the like.

As illustrated in FIGS. **4** and **5**, as described above, each of the head units **252_1** and **252_2** includes the first part U**1**, and the second part U**2** and the third part U**3** in which the widths in the X**1** direction or the X**2** direction are shorter than that of the first part U**1**. The second part U**2** and the third part U**3** are different from each other in the position in the Y**1** direction or the Y**2** direction and the position in the X**1** direction or the X**2** direction. Since the first part U**1**, the second part U**2**, and the third part U**3** have the above-described relationship of width and position, the installation space for the head units **252_1** and **252_2** can be reduced in the X**1** direction or the X**2** direction as compared with the case where each of the head units **252_1** and **252_2** has a simple rectangular shape, for example.

The first part U**1** included in the head unit **252_1** corresponds to "a first part" in which a part of the plurality of nozzles N included in the head unit **252_1** is provided. On the other hand, the first part U**1** included in the head unit **252_2** corresponds to "a fourth part" in which a part included in the plurality of nozzles N included in the head unit **252_2** is provided. The second part U**2** of the head unit **252_1** corresponds to "a second part" in which a part of the plurality of nozzles N included in the head unit **252_1** is provided. On the other hand, the second part U**2** of the head unit **252_2** corresponds to "a fifth part" in which a part of the nozzles N included in the head unit **252_2** is provided. The third part U**3** of the head unit **252_1** corresponds to "a third part" in which a part of the plurality of nozzles N included in the head unit **252_1** is provided. On the other hand, the third part U**3** of the head unit **252_2** corresponds to "a sixth portion" in which a part of the plurality of nozzles N included in the head unit **252_2** is provided.

In the present embodiment, as illustrated in FIGS. **4** and **5**, each of the plurality of nozzles N provided in the head units **252_1** and **252_2**, is provided in any one of the first part U**1**, the second part U**2**, and the third part U**3**. That is, the nozzles N are not provided in a part other than the first part U**1**, the second part U**2**, and the third part U**3** in the head unit **252_1** or **252_2**. Therefore, it is easy to design the head units **252_1** and **252_2** that can reduce the installation space as described above.

Further, as illustrated in FIGS. **4** and **5**, in the head unit **252_1**, the second part U**2** is coupled to the first part U**1** in the Y**2** direction with respect to the first part U**1**. On the other hand, the third part U**3** is coupled to the first part U**1** in the Y**1** direction with respect to the first part U**1**. Therefore, it is easy to design the head unit **252_1** that can reduce the installation space as described above.

Further, as illustrated in FIG. **5**, in the head unit **2521**, the end surface E**2** of the second part U**2** on a third side that is one side of the X**1** direction or the X**2** direction has the same position as the end surface Ela of the first part U**1** on the third side in the X**1** direction or the X**2** direction. In other words, the end surface E**2** and the end surface Ela form a continuous plane. Similarly, the end surface E**3** of the third part U**3** on a fourth side that is the other side of the X**1** direction or the X**2** direction has the same position as the end surface E**1***b* of the first part U**1** on the fourth side in the X**1** direction or the X**2** direction. Therefore, as compared with the case where a step is provided between the end surface E**2** and the end surface Ela or a step is provided between the end surface E**3** and the end surface E**1***b*, the head unit **252_1** and the head unit **252_2** can be densely disposed in the X**1** direction or the X**2** direction.

As illustrated in FIG. **5**, each of the head units **252_1** and **252_2** includes a circulation head H**1** in which one part is positioned in the second part U**2** and the other part is positioned in the first part U**1**, and a circulation head H**2** in which one part is positioned in the third part U**3** and the other part is positioned in the first part U**1**. Therefore, the

plurality of nozzles N can be evenly disposed along the Y axis over the first part U1, the second part U2, and the third part U3.

The circulation head H1 included in the head unit **252_1** corresponds to "a first head" in which a part of the plurality of nozzles N included in the head unit **252_1** is provided. The circulation head H2 included in the head unit **252_1** corresponds to "a second head" in which a part of the plurality of nozzles N included in the head unit **252_1** is provided. On the other hand, the circulation head H1 included in the head unit **252_2** corresponds to "a third head" in which a part of the plurality of nozzles N included in the head unit **252_2** is provided. The circulation head H2 included in the head unit **252_2** corresponds to "a fourth head" in which a part of the plurality of nozzles N included in the head unit **252_2** is provided.

In the present embodiment, as illustrated in FIG. **5**, each of the head units **252_1** and **252_2** has, in addition to the circulation heads H1 and H2 described above, a circulation head H3 positioned in the first part U1 and a circulation head H4 positioned in the first part U1 at a position different from the circulation head H3 in the Y1 direction or the Y2 direction. In the configuration using the circulation heads H1 to H4, compared to the configuration using only the circulation heads H1 and H2, it is possible to increase the number of nozzles N included in the head units **252_1** and **252_2** without increasing the number of nozzles N in the circulation heads H1 and H2. Therefore, it is easy to increase the number of nozzles N included in the head units **252_1** and **252_2**.

The circulation head H3 included in the head unit **252_1** corresponds to "a fifth head" in which a part of the plurality of nozzles N included in the head unit **252_1** is provided. The circulation head H4 included in the head unit **252_1** corresponds to "a sixth head" in which a part of the plurality of nozzles N included in the head unit **252_1** is provided. On the other hand, the circulation head H3 included in the head unit **252_2** corresponds to "a seventh head" in which a part of the plurality of nozzles N included in the head unit **252_2** is provided. The circulation head H4 included in the head unit **252_2** corresponds to "an eighth head" in which a part of the plurality of nozzles N included in the head unit **252_2** is provided.

Further, as illustrated in FIG. **3**, each of the head units **252_1** and **252_2** further includes a holder **33** in which the circulation heads H1 and H2 are disposed. Therefore, the circulation heads H1 and H2 can be integrated by the holder **33**. In addition to the circulation heads H1 and H2, the circulating heads H3 and H4 are disposed in the holder **33** of the present embodiment. Therefore, the circulation heads H1 to H4 are integrated by the holder **33**. The holder **33** included in the head unit **252_1** corresponds to "a first holder". On the other hand, the holder **33** included in the head unit **252_2** corresponds to "a second holder".

Further, as illustrated in FIG. **3**, each of the head units **252_1** and **252_2** further includes a fixing plate **36** that fixes the circulation heads H1 and H2 to the holder **33**. Therefore, the integrity of the circulation heads H1 and H2 can be enhanced as compared with the configuration in which the fixing plate **36** is not used. The fixing plate **36** of the present embodiment fixes the circulation heads H1 and H2 as well as the circulation heads H3 and H4 to the holder **33**. Therefore, the integrity of the circulation heads H1 to H4 is enhanced. The fixing plate **36** included in the head unit **252_1** corresponds to "a first fixing plate". On the other hand, the fixing plate **36** included in the head unit **252_2** corresponds to "a second fixing plate".

As illustrated in FIG. **5**, each of the circulation heads H1 and H2 has nozzle rows La and Lb. Therefore, the pitch between the nozzles N in the nozzle row La or Lb can be reduced as compared with the configuration in which the nozzle row La or Lb extends over the circulation head H1 and the circulation head H2. Each of the nozzle rows La and Lb included in the head unit **252_1** corresponds to "a first nozzle row" in which a part of the plurality of nozzles N included in the head unit **252_1** is arranged in the Y1 direction or the Y2 direction. On the other hand, each of the nozzle rows La and Lb included in the head unit **252_2** corresponds to "a second nozzle row" in which a part of the plurality of nozzles N included in the head unit **252_2** is arranged in the Y1 direction or the Y2 direction.

2. Second Embodiment

FIG. **12** is a plan view illustrating a disposition of two head units **252_1** and **252_2** according to a second embodiment. In the present embodiment, a position P1 of the head unit **252_1** differs from a position P2 of the head unit **252_2** in the Y1 direction or the Y2 direction. FIG. **12** illustrates a configuration in which the head unit **252_1** is positioned more Y2 direction side than the head unit **252_2**. The head unit **252_1** may be positioned more Y1 direction side than the head unit **252_2**. The position P1 is a position defined with reference to a position of the geometric center of gravity of the head unit **252_1** viewed from the Z1 direction or the Z2 direction. The position P2 is a position defined similarly to the position P1 with reference to a position of the geometric center of gravity of the head unit **252_2** viewed from the Z1 direction or the Z2 direction.

When the length of the head unit **252_1** in the Y1 direction or the Y2 direction is denoted by d1, the shift ΔL between the position P1 of the head unit **252_1** and the position P2 of the head unit **252_2** in the Y1 direction or the Y2 direction is desirably smaller than d1/2. When the shift ΔL becomes d1/2, that is, when the position P2 of the head unit **252_2** is positioned at the center of the Y axis of the head unit **252_1**. In that case, the circulation head H4 of the head unit **252_1** and the circulation head H2 of the head unit **252_2** become at the same position on the Y axis, and the circulation head H2 of the head unit **252_1** and the circulation head H4 of the head unit **252_2** become at the same position on the Y axis. That is, the circulation heads having a large discharging amount are overlapped between the head unit **252_1** and the head unit **252_2**. Therefore, the difference in the total discharging amount with respect to other regions becomes large, and there is a possibility that the image quality may deteriorate due to a large difference in density. Therefore, the shift ΔL is desirably smaller than d1/2. The shift ΔL is more desirably smaller than d1/4, further desirably smaller than d1/8. By reducing the shift ΔL, the above-described discharging unevenness reducing effect is remarkably exhibited.

As in the present embodiment, in a case where the position P1 and the position P2 in the Y1 direction or the Y2 direction do not coincide and there is a shift ΔL, and when the pitch of the nozzles N in the Y1 direction or the Y2 direction is denoted by LP, it is desirable that $\Delta L \neq Lp \times n$ (n is an integer). When this relationship is satisfied, in the Y1 direction or the Y2 direction, the position of the nozzle N of the head unit **252_1** and the position of the nozzle N of the head unit **252_2** are different, and as a result, the high resolution of the printed image can be achieved. Further, it is desirable that $\Delta L = LP \times (n+1/2)$. When this relationship is satisfied, in a position of the middle of two nozzles N

adjacent to each other in the Y axis of one head unit, one nozzle N of the other head unit is positioned, thereby it is possible to print an image with a higher quality.

However, the relationship of ΔL=LP×n may be satisfied. In this case, similarly to the above-described first embodiment, the disposition density of the nozzles N in the X1 direction or the X2 direction can be increased, and as a result, the printing speed can be increased.

When the length of the head unit **252_2** in the Y1 direction or the Y2 direction is denoted by d2, d1=d2. Therefore, the positional shift between the ends of the head units **252_1** and **252_2** in the Y1 direction or the Y2 direction becomes the shift ΔL, and the shift ΔL can be easily adjusted. The length d1 and the length d2 may be different.

3. Modification Example

The form illustrated above may be variously modified. A specific aspect of modification that can be applied to the above-described embodiments is illustrated below. Any two or more aspects selected from the following examples can be appropriately combined within a range not inconsistent with each other.

1. In the above-described embodiment, the number of circulation heads Hn included in one head unit **252** is four, but the number of circulation heads Hn included in one head unit **252** may be three or less or five or more.

FIG. **13** is a plan view illustrating a disposition of two head units **252_1** and **252_2** according to a modification example. The head units **252_1** and **252_2** illustrated in FIG. **13** include two circulation heads H1 and H2. In FIG. **13**, a case where the discharging amount of the ink in the circulation head H1 smaller than the discharging amount of the ink in the circulation head H2 is illustrated. However, in the present embodiment, a part of the ranges of the circulation heads H1 and H2 in the Y1 direction or the Y2 direction overlap in the first part U1. According to the above modification example, the same effect as the above-described embodiment can be obtained.

2. In the above-described embodiment, the plurality of head units **252** supported by the support member **251** have the same configuration, but the configuration of the head unit **252** corresponding to the first head unit and the configuration of the head unit **252** corresponding to the second head unit may be different from each other.

3. In the above embodiment, different kinds of ink are supplied to the supply flow path Sa and the supply flow path Sb, but the same kind of ink may be supplied to the supply flow path Sa and the supply flow path Sb.

4. In the above-described embodiment, the sub tank **13** is provided outside the head unit **252**, and the ink is circulated between the head unit **252** and the sub tank **13**, but instead of the sub tank, any system may be used as long as the system circulates ink between the head unit **252** and the outside of the head unit **252**. For example, the ink may be circulated between the head unit **252** and the liquid container **12**.

5. In the above-described embodiment, the serial type liquid discharging apparatus in which the transporting body **241** having the head unit **252** mounted thereon is reciprocated has been exemplified, but the present disclosure can be applied to a line type liquid discharging apparatus in which a plurality of nozzles N are distributed over the entire width of the medium **11**.

6. The liquid discharging apparatus exemplified in the above-described embodiment can be adopted not only in an apparatus dedicated to printing but also in various apparatus such as a facsimile apparatus and a copying machine. Moreover, the application of the liquid discharging apparatus is not limited to printing. For example, a liquid discharging apparatus that discharges a solution of a coloring material is utilized as a manufacturing apparatus that forms a color filter of a display apparatus such as a liquid crystal display panel. Further, a liquid discharging apparatus that discharges a solution of a conductive material is utilized as a manufacturing apparatus that forms wiring or electrodes of a wiring substrate. Further, a liquid discharging apparatus that discharges a solution of an organic substance related to a living body is utilized, for example, as a manufacturing apparatus that manufactures a biochip.

7. The circulation head Hn illustrated in the above-described embodiment is formed by laminating a plurality of substrates, which are not illustrated in the figure, but the above-mentioned each component of the circulation head Hn is appropriately provided. For example, the nozzle row La and the nozzle row Lb are provided on a nozzle substrate. The liquid storage chamber Ra and the liquid storage chamber Rb are provided on a reservoir substrate. The plurality of pressure chambers Ca and the plurality of pressure chambers Cb are provided on a pressure chamber substrate. The plurality of driving elements Ea and the plurality of driving elements Eb are provided on an element substrate. One or more of the above nozzle substrate, reservoir substrate, pressure chamber substrate, and element substrate are individually provided for each circulation head Hn. For example, when the nozzle substrate is provided individually for each circulation head Hn, one or more of the reservoir substrate, the pressure chamber substrate, and the element substrate may be commonly provided for the plurality of circulation heads Hn in the head unit **252**. Further, when the reservoir substrate and the pressure chamber substrate are individually provided for each circulation head Hn, the nozzle substrate or the like may be provided commonly for the plurality of circulation heads Hn in the head unit **252**. Furthermore, the driving circuits for driving the plurality of driving elements Ea and the plurality of driving elements Eb may be provided individually for each circulation head Hn, or may be provided commonly for the plurality of circulation heads Hn in the head unit **252**.

What is claimed is:

1. A liquid discharging apparatus comprising:

a first head unit provided with a plurality of nozzles that discharge a liquid; and

a second head unit provided with a plurality of nozzles that discharge the liquid, wherein

the first head unit includes

a plurality of first nozzles arranged in a first direction,

a first flow path communicating with the plurality of first nozzles,

a first supply port supplying the liquid from an outside of the first head unit to the first flow path, and

a first exhaust port exhausting the liquid from the first flow path to the outside of the first head unit,

the second head unit includes

a plurality of second nozzles arranged in the first direction,

a second flow path communicating with the plurality of second nozzles,

a second supply port supplying the liquid from an outside of the second head unit to the second flow path, and

a second exhaust port exhausting the liquid from the second flow path to the outside of the second head unit,

in the first head unit, the first supply port is positioned on a first side, which is one side of the first direction, and the first exhaust port is positioned on a second side, which is an other side of the first direction with respect to a center of the plurality of first nozzles,

in the second head unit, the second supply port is positioned on the second side and the second exhaust port is positioned on the first side with respect to a center of the plurality of second nozzles, and

the first head unit and the second head unit are arranged in a second direction intersecting with the first direction.

2. The liquid discharging apparatus according to claim **1**, wherein

a shift between a position of the first head unit and a position of the second head unit in the first direction is smaller than d**1**/2, wherein a length of the first head unit in the first direction is d**1**.

3. The liquid discharging apparatus according to claim **2**, wherein

d**1**=d**2**, wherein a length of the second head unit in the first direction is d**2**.

4. The liquid discharging apparatus according to claim **1**, wherein

a position of the first head unit and a position of the second head unit in the first direction coincide with each other.

5. The liquid discharging apparatus according to claim **1**, further comprising:

a support member supporting the first head unit, wherein

the first head unit further includes a first fixing portion configured to fix the first head unit to the support member in a first posture and a second fixing portion configured to fix the first head unit to the support member in a second posture which is different from the first posture.

6. The liquid discharging apparatus according to claim **5**, wherein

each of the first fixing portion and the second fixing portion is provided with a hole for screwing, and

the support member includes a first screwing portion to which the first fixing portion is screwed in the first posture, and a second screwing portion to which the second fixing portion is screwed in the second posture.

7. The liquid discharging apparatus according to claim **1**, wherein

the first head unit is provided with an identification portion configured to identify whether the first supply port is positioned on the first side with respect to the center of the plurality of first nozzles.

8. The liquid discharging apparatus according to claim **1**, wherein

the first head unit has

a first part in which a part of the plurality of first nozzles is provided,

a second part in which a part of the plurality of first nozzles is provided and a width of the second part is shorter than a width of the first part in the second direction, and

a third part in which a part of the plurality of first nozzles is provided, each of a position in the first direction and a position in the second direction is different from that of the second part, and a width of the third part is shorter than a width of the first part in the second direction, and

the second head unit has

a fourth part in which a part of the plurality of second nozzles is provided,

a fifth part in which a part of the plurality of second nozzles is provided and a width of the fifth part is shorter than a width of the fourth part in the second direction, and

a sixth part in which a part of the plurality of second nozzles is provided, each of a position in the first direction and a position in the second direction is different from that of the fifth part, and a width is shorter than a width of the fourth part in the second direction.

9. The liquid discharging apparatus according to claim **8**, wherein

each of the plurality of first nozzles is provided in any of the first part, the second part, and the third part, and

each of the plurality of second nozzles is provided in any of the fourth part, the fifth part, and the sixth part.

10. The liquid discharging apparatus according to claim **8**, wherein

the second part is coupled to the first part on the first side with respect to the first part, and

the third part is coupled to the first part on the second side with respect to the first part.

11. The liquid discharging apparatus according to claim **8**, wherein

an end surface of the second part on a third side that is one side of the second direction has an identical position in the second direction with an end surface of the first part on the third side, and

an end surface of the third part on a fourth side that is the other side of the second direction has an identical position in the second direction with an end surface of the first part on the fourth side.

12. The liquid discharging apparatus according to claim **8**, wherein

the first head unit has

a first head in which a part of the plurality of first nozzles is provided, and one part of the first head is positioned in the second part and an other part of the first head is positioned in the first part, and

a second head in which a part of the plurality of first nozzles is provided, and one part of the second head is positioned in the third part and an other part of the second head is positioned in the first part, and

the second head unit has

a third head in which a part of the plurality of second nozzles is provided, and one part of the third head is positioned in the fifth part and an other part of the third head is positioned in the fourth part, and

a fourth head in which a part of the plurality of second nozzles is provided, and one part of the fourth head is positioned in the sixth part and an other part of the fourth head is positioned in the fourth part.

13. The liquid discharging apparatus according to claim **12**, wherein

the first head unit has

a fifth head in which a part of the plurality of first nozzles is provided and which is positioned in the first part, and

a sixth head in which a part of the plurality of first nozzles is provided and which is different in position from the fifth head in the first direction, and is positioned in the first part, and

the second head unit has

a seventh head in which a part of the plurality of second nozzles is provided and which is positioned in the fourth part, and

an eighth head in which a part of the plurality of second nozzles is provided and which is different in position from the seventh head in the first direction, and is positioned in the fourth part.

14. The liquid discharging apparatus according to claim **12**, wherein

the first head unit further includes a first holder in which the first head and the second head are disposed, and

the second head unit further includes a second holder in which the third head and the fourth head are disposed.

15. The liquid discharging apparatus according to claim **14**, wherein

the first head unit further includes a first fixing plate that fixes the first head and the second head to the first holder, and

the second head unit further includes a second fixing plate that fixes the third head and the fourth head to the second holder.

16. The liquid discharging apparatus according to claim **12**, wherein

each of the first head and the second head has a first nozzle row in which a part of the plurality of first nozzles is arranged in the first direction, and

each of the third head and the fourth head has a second nozzle row in which a part of the plurality of second nozzles is arranged in the first direction.

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